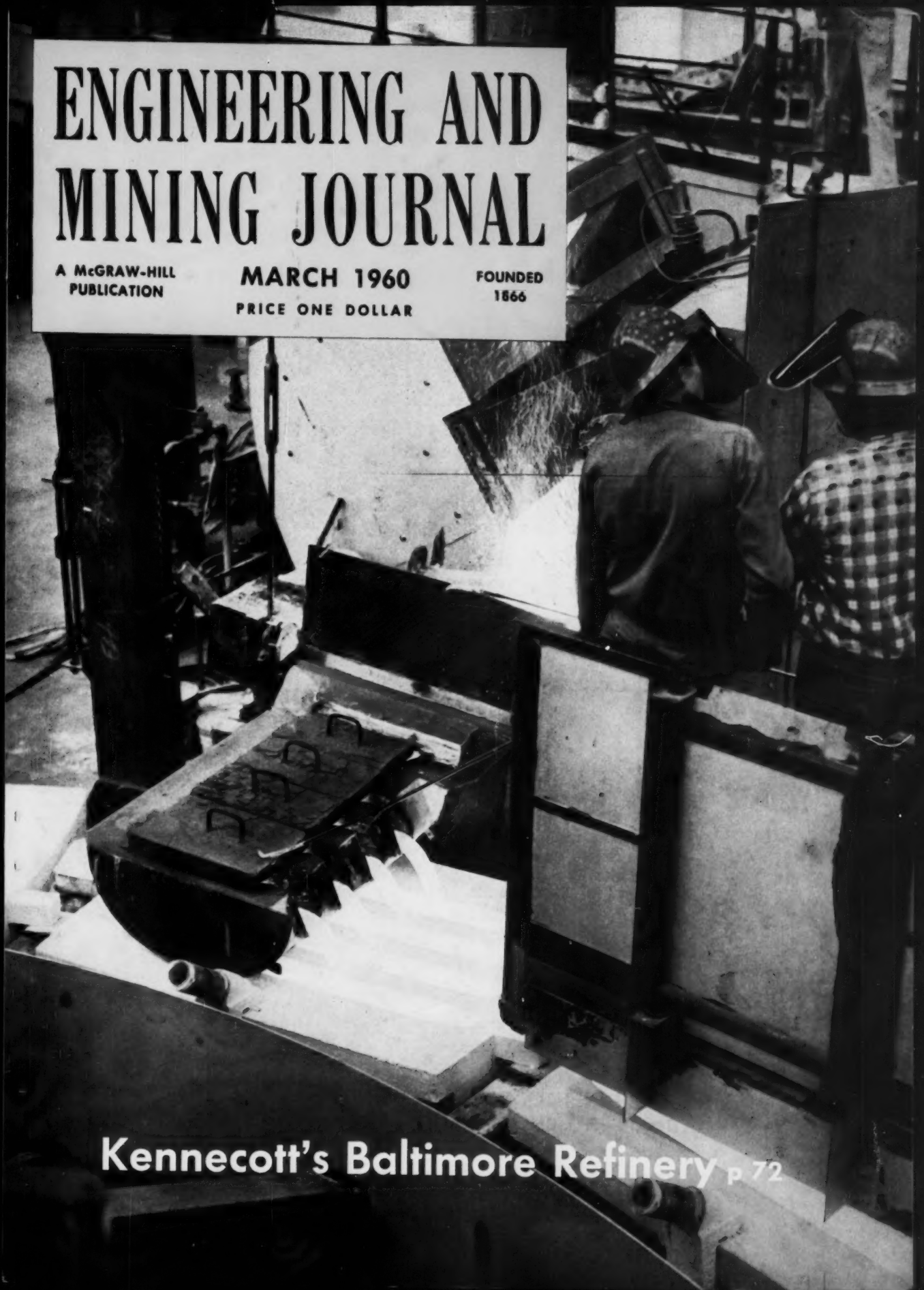
ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

MARCH 1960

PRICE ONE DOLLAR

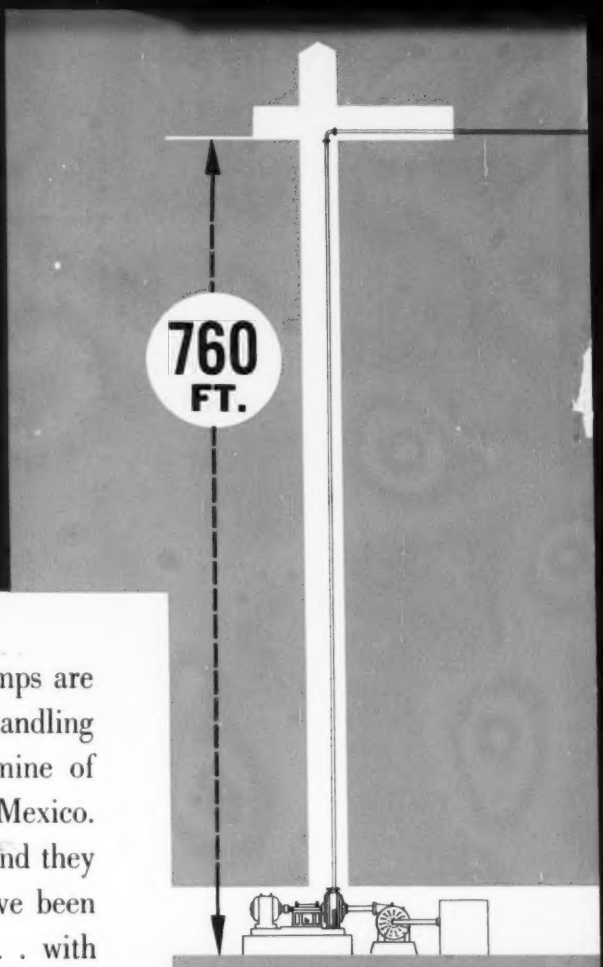
FOUNDED 1866



Kennecott's Baltimore Refinery P 72

From New Mexico . . .

a success report on HIGH-HEAD DIRTY-WATER pumping



Two heavy-duty C-5-frame Hydroseal pumps are giving notable trouble-free service in handling dirty* underground water in a uranium mine of Kermac Nuclear Fuels Corp., Grants, New Mexico. Operating in series, they pump 600 GPM and they develop 360 PSI gauge pressure. They have been pumping efficiently since April, 1959 . . . with practically no maintenance.

*Less than 5% solids.

These C-5-frame Hydroseals are all-metal pumps. Their wearing parts are of abrasion-resistant alloy steel. They are designed for 400-pound service.

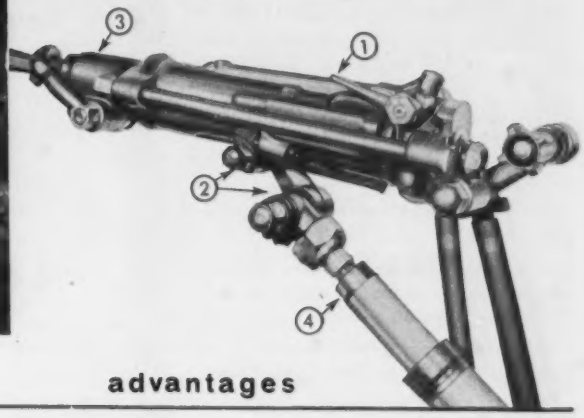
A-S-H engineered pumps, properly applied, usually solve the pumping problem. Write us about yours.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—P.O. Box 635, Paoli, Pa.
Representatives throughout the World

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED

the *new* JR-38C UNIVERSAL JACKDRILL

New features mean easier setups, faster drilling - and extra stamina keeps it underground!



features	advantages
1 **5-POSITION THROTTLE**	All drilling functions are on one convenient control — blowing, feeding, collaring, drilling. In feeding position, feed-leg pressure is adjusted by a roll-type valve on drill handle.
2 **INTEGRAL FEED LEG WITH ADJUSTABLE TENSION & BALANCE**	Only one air hose connection needed — air from drill casing passes to the leg through built-in connection. Tension on knee joint and balance of drill on leg both adjustable to suit operator's preference.
3 **STOPER-TYPE FRONTHEAD CONSTRUCTION**	Fronthead fits into deep counterbore in cylinder, providing extra strength and rigidity that means longer trouble-free performance in feed-leg drilling.
4 **TELESCOPIC FEED LEG**	Telescoping leg extends from 55″ to 127″ — provides greater feeding pressure on high back holes without auxiliary extensions.
SPOOL TYPE DOUBLE KICKER PORT VALVE	New valve design, using famous I-R double kicker port principle, has larger direct air ports to both sides of piston — *increases drilling efficiency 20% or more!*
RETRACTABLE AIR FEED	Retracts feed leg quickly by air pressure, saving time in moving from completed hole to new position.

For *drifter dependability* in a light-weight feed-leg drill, try the new JR-38C. Ask your I-R distributor or engineer for complete information.

Ingersoll-Rand
104A5 ▼ 11 Broadway, New York 4, N.Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

Mining Calendar

Lead Industries Association and American Zinc Institute joint meeting, Chase-Park Plaza Hotels, St. Louis, Mo., April

National Western Mining Conference and Exhibition. Denver Hilton, April 21-23

Fifth Annual Mining, Minerals and Petroleum Conference, sponsored by Alaska and Southwest Alaska Sections, AIME, and University of Alaska. On the campus at College, Alaska, April 11-13

Southwest Metals & Minerals Conference, AIME, Los Angeles, Calif. April 21-23

Gold and Money Session, 1960 Pacific Northwest Metals & Minerals Conference, AIME, Portland, Ore., April 28-30

15th Industrial Waste Conference, Purdue University, Memorial Union Building, May 3-5

36th Annual Conference, Lake Superior Mines Safety Council. Hotel Duluth, Duluth, Minn., May 19-20.

American Society of Mechanical Engineers, Oil and Gas Power Div., Hotel Muehleback, Kansas City, Mo., May 23-26

International Congress on Research into Ground Control and Rock Mechanics, Paris, France, May 16-20

Wyoming Mining Association, Jackson Lake Lodge, Wyo. June 10-11

XXI International Geological Congress, University of Copenhagen, Denmark. American Geological Institute, 2101 Constitution Avenue, N.W., Washington 25, D.C. Aug. 15-25

International Mining Congress, Hungarian Mining & Metallurgical Society, Budapest, Sept. 12-18

Coming Up

In April—Thirty-six pages on the Toquepala project in Peru, with on the spot photos by E&MJ and Ray Manley (above), photographer of Tucson.

93rd YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

MARCH 1960

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Volume 161, No. 3

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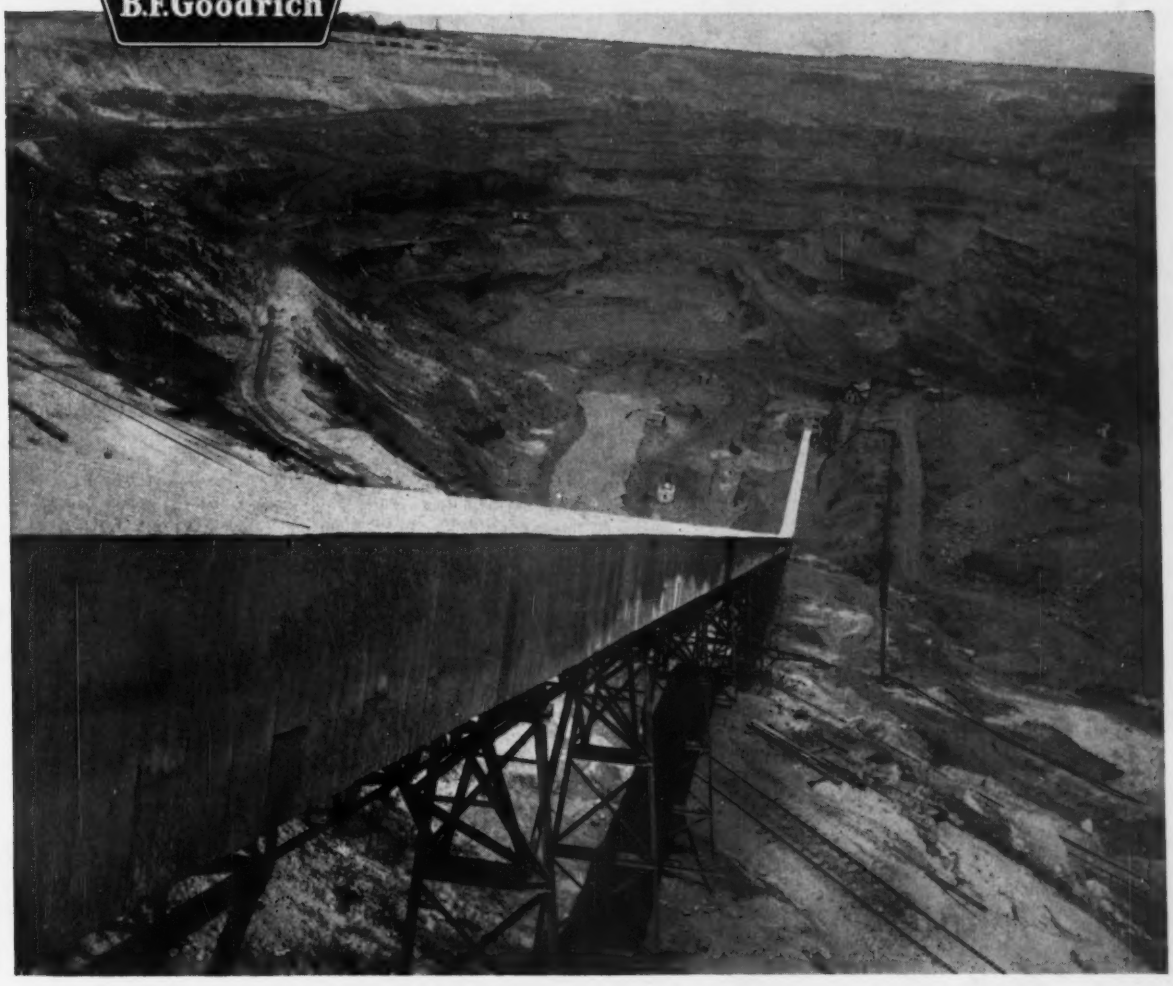
B.F.Goodrich



Nine million tons came up here

B. F. Goodrich improvements in rubber brought extra savings

OUT of that man-made hole (so deep a 30-story skyscraper wouldn't reach the top) enough iron ore has come up in the last ten years to make the steel for 2½ million automobiles. A cubic foot of the stuff weighs 125 pounds; it comes up the steep hill, ⅓ of a mile long, at the rate of 18 tons a minute.

A hole this deep once would have needed at least three belts dumping from one to the other. No belt was strong enough to pull all the weight the whole distance.

Then B.F.Goodrich developed a steel-wire-and-rubber belt, with twisted wire strands running lengthwise, each strand completely surrounded by rubber. There is half a mile of wire in every foot. Now one long belt does the whole job, has carried over 9 million tons, is still in use. It has lasted longer than any conveyor belt ever made with steel cords or cables.

This stronger conveyor belt is typical of what happens when B.F.Goodrich engineers set out to improve a product so that it will last longer, stand more abuse. That's why it pays to call a B.F.Goodrich distributor before you buy rubber products, let him tell you what new developments B.F.Goodrich has made in them.

At this iron mine money was saved by eliminating "transfer points", which would have been necessary in any system built in several stages with ordinary belts. Fewer transfer points meant less expensive equipment in the first place, and maintenance cost was reduced every year. *B.F.Goodrich Industrial Products Co., Dept. M-808, Akron 18, Ohio.*

B.F.Goodrich *industrial rubber products*

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Articles in this issue of

ENGINEERING AND MINING JOURNAL

Continued from p 2

72 **Kennecott Opens Baltimore Refinery**

Dedication of a $30-million electrolytic copper refinery will be held this spring in Anne Arundel County, Md., when the new "Baltimore" refinery of Kennecott Copper Corp. officially goes on stream. The refinery will take blister copper from Kennecott's properties in Sewell, Chile, and from various properties in the U.S. West.

E&MJ visited the plant in late December 1959, and with the kind cooperation of the operating staff at Baltimore, can now present five pages of technology and background, including a flowsheet of the circuit.

An interesting sidelight to the Baltimore story was the search for a site for the plant, which started long before the first contracts were signed. Kennecott officials, including Ivor G. Pickering, refinery manager, visited some 25 possible sites, checking transportation, power, potable water and labor resources. They wound up on the Patapsco River, south of Baltimore, and directly opposite Bethlehem's Sparrows Point steel works. The refinery meets all the qualifications of a major industrial contribution to the economy—modern techniques, modern equipment, modern management—and all the qualifications of a good neighbor in its community—attractive structures, tasteful design, and efficient and safe working conditions.

82 **Fred Bond—Action in a Rod Mill**

Rod mill efficiency, as it can be measured by a work index, reduction ratio and power draft, is seriously affected by broken rods in the charge and can be greatly reduced by rods too small for the size and hardness of the ore particles. The thoughtful conclusions of Mr. Bond's tests and observations are presented in the article on p 82.

86 **Tunnel Boring Through Harder Rocks**

"Here was a tunneling method potentially competitive with present day cyclic operations in which advances of 60 to 90 ft per day might be expected under favorable conditions." The catch, of course, in the quote from this month's article on the Robbins Borer is ". . . under favorable conditions." But James S. Robbins & Associates of Seattle have been putting their machines into more and more difficult locations since the first borer went to work several years ago—and each challenge has been met with new design improvements and remarkable success. E&MJ is grateful to the manufacturing firm for their cooperation and great help in bringing this progress report to its readers.

104 **New Instruments—New Technology**

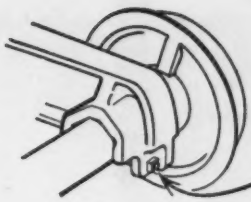
The first page of this month's Operating Ideas is devoted to two significant breakthroughs in new equipment. The Berylometer, first mentioned in the Mt. Wheeler beryllium find story (E&MJ, November 1959, p 18) was described at last month's AIME meeting by Louis and Pauline Moyd. We have based our report on that paper and upon information from the manufacturer of the new tool.

On the same page, there is a brief description of a gas turbine engine in operation on a truck at an International Nickel property, another of the developments to watch in Mining 1960.

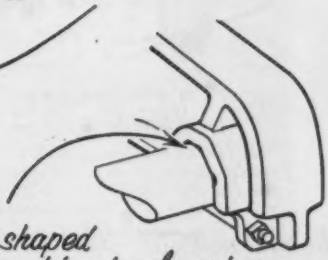
24 **The Washington Scene—And Mineral Support**

Congressional experts are gloomy about the chances for significant aid to the mining industry during the remaining months of this session. Divisions in the industry have weakened the efforts of mining state legislators.

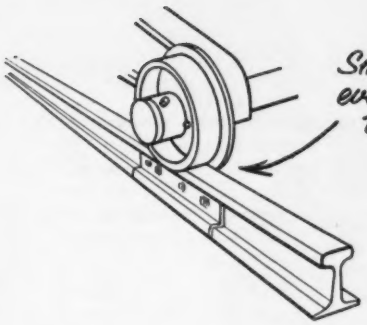
Movement between bolster and side frame is taken on specially designed wear surfaces



Quick wheel change

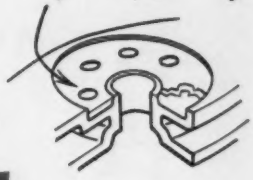


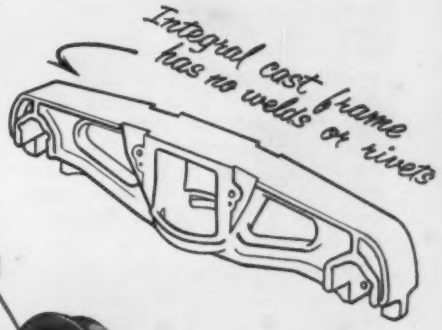
V-shaped machined axle grips for controlled flexibility and truck alignment



Smoother ride even on rough tracks

Large center bearing for longer life



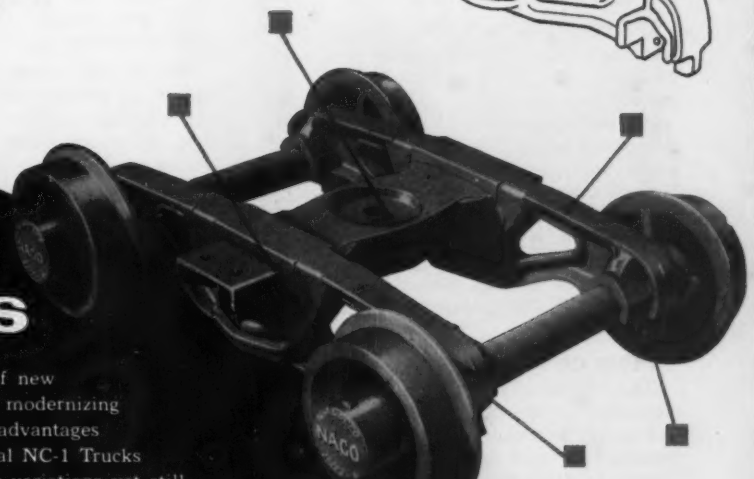


Integral cast frame has no welds or rivers

Check these "plus" features

OF

NATIONAL NC-1 TRUCKS



If you're considering the purchase of new 8-wheel mine cars . . . or if you're thinking of modernizing older cars—*now* is the time to check the advantages of National NC-1 Trucks. National NC-1 Trucks have controlled flexibility for track variations yet still maintain truck alignment through their machined V-shaped axle grips. In addition, NC-1 Trucks have a built-in shock absorbing mechanism.

You get more out of your mine car investment per workshift . . . per day . . . per year. And at the same time you minimize spillage . . . get greater protection for your equipment, track and structures . . . slash maintenance to a new low.

Yes, *now* is the time to check National NC-1 Trucks—they make sense for 8-wheel mine cars . . . *make dollars for operators*, too.

- WILLISON AUTOMATIC COUPLERS
- RUBBER CUSHIONED UNITS
- NC-1 CAR TRUCKS • NACO STEEL WHEELS
- NACO STEEL LINKS & SWIVEL HITCHINGS

AA-5077

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

Established 1868 *Cleveland 6, Ohio*

94 YEARS OF MINING

The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which subsequently became the ENGINEERING & MINING JOURNAL. The column will appear in this space monthly.

COLORADO, MARCH 1866 — Colorado is a good illustration of the uncertainties of mining. Its gold-bearing quartz opened very richly . . . thus quartz mills with an aggregate of 2,000 stamps were sent and mines opened. But at a certain depth the character of the veins changed. The gold associated with pyrites of iron could not be separated . . . From that day mining has been practically suspended. Of course American ingenuity will prove equal to the emergency.

NEVADA, MARCH 1866 — . . . a gentleman who recently arrived from Montana, does not give so highly-colored an account of the country as we are in the habit of hearing upon the streets daily. He says that the mines are not so good as those of Nevada County. They can be worked but few months in the year, on account of the severity of the climate, and many poor fellows have their limbs frozen in the winter. Every necessary of life commands famine prices.

SILVER CITY, IDAHO, MARCH 1866 —The Owyhee silver mine, so seldom mentioned by the press of California and always depreciated by the press of Nevada, are now acknowledged by visitors to this section to be the richest ever known. We have many ledges that cannot be excelled in richness, in both gold and silver. Also, cinnabar, tin and diamonds abound.

BRITISH COLUMBIA, MARCH 1866 —To show the faith which the governments of British Columbia and Vancouver's Island have in the Big Bend mines they are laying out over $25,000 to complete the wagon road to Kamloops, and have given a subsidy to two steamboat companies of over $60,000 to run direct from San Francisco to Victoria and New Westminster. In addition to this the Hudson Bay Co. are building a new steamer on Kamloops Lake, in time for the spring trade, to the mines exclusively, at an outlay of over $50,000.

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

Behind the By-Lines

We were saddened last month to learn of the death of Charles E. Newmeyer, former editor and publisher of the Denver MINING RECORD, after an illness of a few weeks. We had taken note only last month of Mr. Newmeyer's retirement from his editorial post, but were looking forward to the continuation of his role as E&MJ's Denver area correspondent, a post he had filled for more than 12 years, to the great satisfaction of our readers and ourselves.

He died Jan. 28, at the age of 73, a veteran of 50 years of careful, authoritative coverage of the mining industry of the western United States. Mr. Newmeyer was born and educated in Denver schools and joined his newspaper in 1909, when it was published in Colorado Springs. He moved back to Denver with the paper in 1915 and became its editor, later purchasing it.

Mr. Newmeyer was unique, both in the mining industry and the journalistic profession. He had an equally warm regard for his readers and his career—and knew what so many lesser practitioners of the art never learn—that news is made by people and is only valuable when it informs and enlightens people.

His cluttered office in Denver was in the tradition of the old-time newspaper shop: busy without frenzy, informed without bombast or preachment. We made it a point on our visits to Denver to stop in and see Mr. Newmeyer and his competent staff, which included his sisters, Mrs. Joan West and Miss Rose Newmeyer. We always came away charmed by their hospitality and grateful for their company.

In his role as correspondent for E&MJ, Mr. Newmeyer never failed his obligations and, in true professional style, usually exceeded them. For more than a decade he was a trusted associate and a fond friend.

Because of his long association with the industry, and because of his warm regard for it, Mr. Newmeyer's copy each month was often accompanied by a note, scrawled in pencil, in which he might comment on a given news story or a too-promotional announcement with a wry reference to the overworked "enthusiasm machine" of the mine owners, or the "re-saddling of a dead horse." But the notes just as often contained a proud declaration—when an old friend finally proved up a dream or an old mine came back into production.

Charles Newmeyer was an ardent partisan in mining's cause, but never a rabid one. He never let his dedication push him beyond his own exact code of reason, of moderation, of devotion to his craft and his country.

We would call your attention to the change in the heading on the column at left. Our magazine is 94 years old this month. We are grateful to the men like Charles Newmeyer who have added to the meaning and value of those years.

Heavy load of uranium ore travels 48" belt in Elliot Lake area.

LIMBEROLLER® CONVEYOR IDLERS ABSORB "BUMP"—INCREASE BELT LIFE

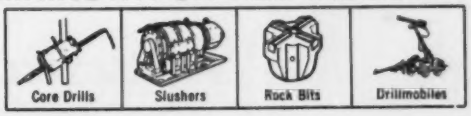
Joy Limberoller Conveyor Idlers increase belt life because the "bump," which is a prime source of belt wear, is harmlessly absorbed. Unlike steel idlers, which are rigidly mounted and unyielding, Limberoller idlers carry the belt on resilient neoprene discs which are moulded to flexible wire rope. The two ends of the wire rope are locked in bearings which are free to turn in the yokes which support them. This type of construction is strong, yet it permits enough "give" in the idler to eliminate the punishing "bump" as the belt hits the idler. This flexibility also improves belt training.

1172

Limberoller idler design not only increases belt life, but can give the idler up to ten times the service life of steel idlers. Bearings are placed up out of the way of spillage, which is particularly important when handling abrasive materials. The neoprene discs are corrosion resistant, and they are self-cleaning with even the stickiest of materials. Lubrication and servicing is easy, because the bearings are completely clear of the belt.

For complete details on how Joy Limberoller idlers can reduce your cost-per-ton in handling any bulk materials, write for Bulletin **1172-4.**

EQUIPMENT FOR MINING...FOR ALL INDUSTRY



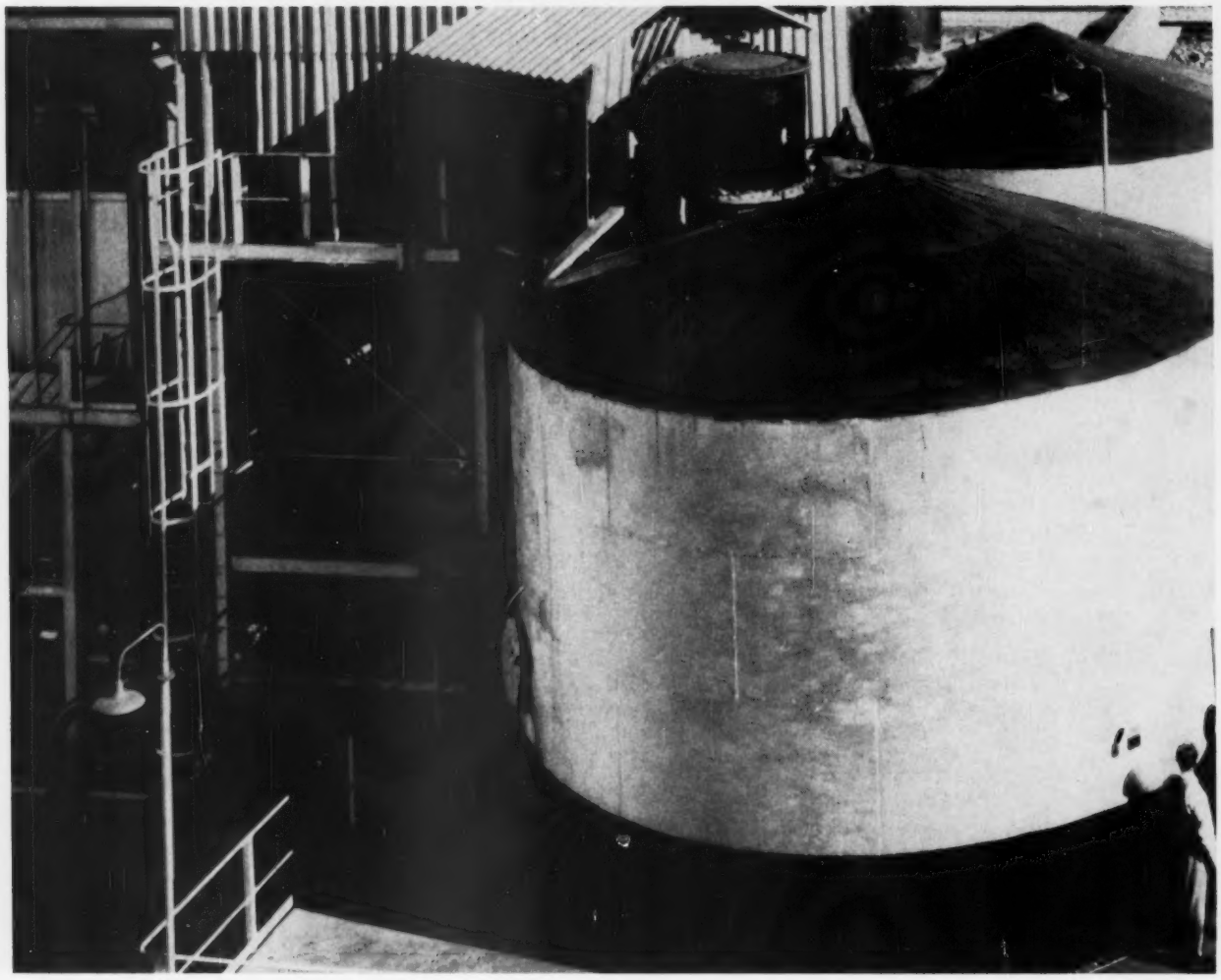
JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

SO_2 production in the Transvaal

FluoSolids® PLAYS MAJOR ROLE IN



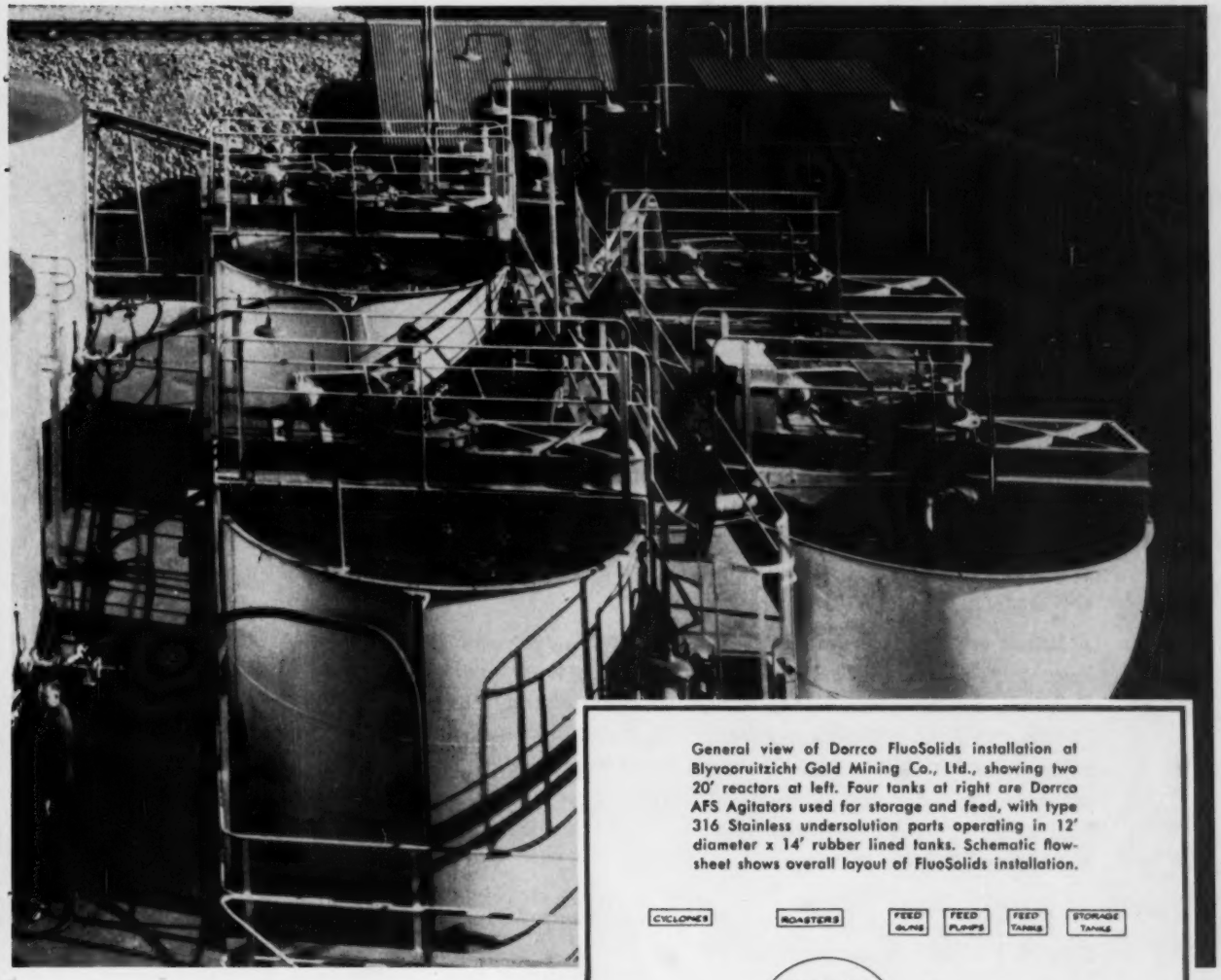
Blyvooruitzicht Gold Mining Co. Ltd.'s contact acid plant, near Johannesburg, has been cited as a model operation from an efficiency and appearance standpoint. Playing an important role in the overall effectiveness of the plant is the Dorrco FluoSolids System for pyrites roasting. Consisting of two 20′ I.D. reactors plus auxiliary equipment, the roasting section produces sufficient SO_2 gas for the production of 150 tpd H_2SO_4 (100%).

On stream since October, 1956, the "Blyvoor" plant is but one of a long succession of highly effective installations in South Africa. Since this start-up, Rand Mines Ltd., parent company of "Blyvoor," has installed a second system comprised of two 18′ I.D. reactors in their Harmony Gold Mining Co. Ltd. plant, bringing the total number of Dorrco FluoSolids pyrites roaster on stream to 21 in South Africa alone.

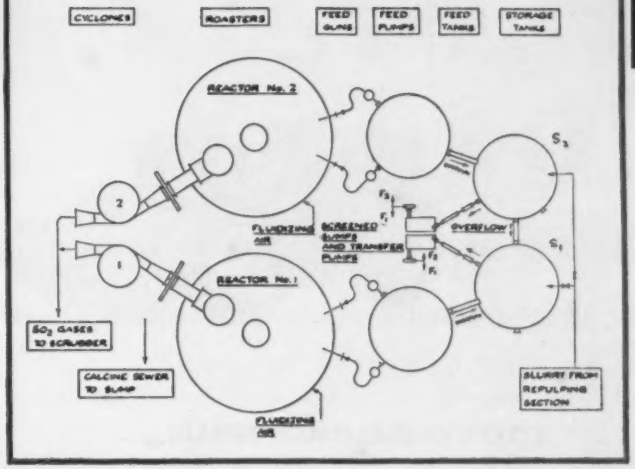
This system is additionally significant in that it includes many refinements over previous pyrites roasters erected in South Africa—among them an improved repulping system capable of handling a day's requirements in less than 6 hours.

Total feed rate for each reactor is 90.5 lbs/min. dry basis 42% S pyrite filter cake. Total gas to scrubber from both reactors is 31,700

MODEL 150 TPD ACID PLANT



General view of Dorrco FluoSolids installation at Blyvooruitzicht Gold Mining Co., Ltd., showing two 20' reactors at left. Four tanks at right are Dorrco AFS Agitators used for storage and feed, with type 316 Stainless undersolution parts operating in 12' diameter x 14' rubber lined tanks. Schematic flowsheet shows overall layout of FluoSolids installation.



CFM at 1200°F, 12.5 psia. Gas strength averages 11-12% SO_2 on a dry basis.

Dorr-Oliver's associated company in South Africa, Edw. L. Bateman, Ltd., handled all equipment and engineering for the "Blyvoor" and Harmony roasting plants—another example of Dorr-Oliver's thorough-going service on every continent.

If there is a step in your flowsheet where intimate contact between solids and gases is essential, the Dorrco FluoSolids system of fluidization should be investigated. Just write Dorr-Oliver Incorporated, Stamford, Conn.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

Dorrco, FluoSolids – Reg. T.M. U.S. Pat. Off.

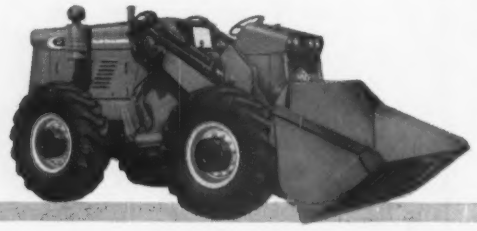
LIKE A LOADER WITH EXTRA REACH?

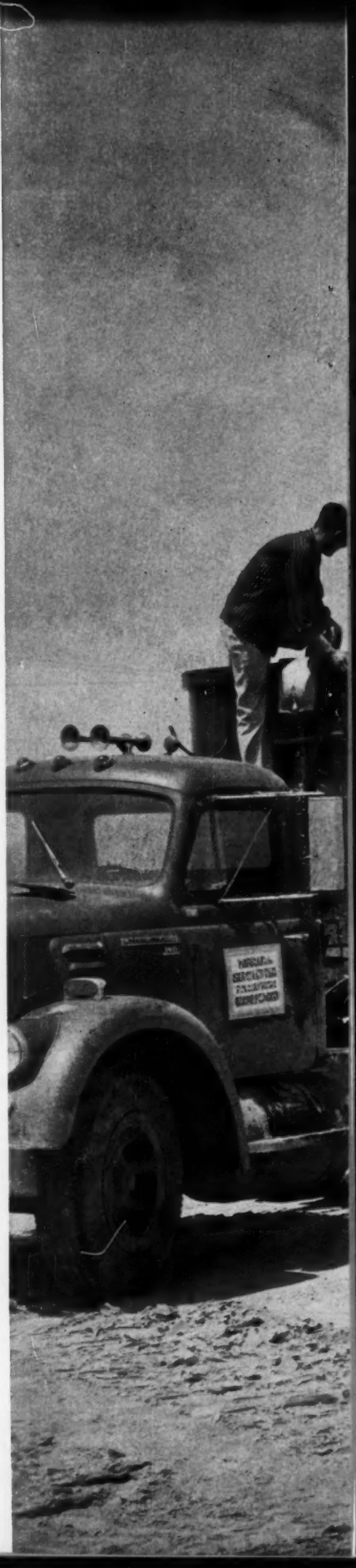
The TL-20 has it! Means fast, even dumping into high-sided trucks—no wasting time leveling material to distribute it evenly.

That extra foot or two of reach that you get with a TL-20 tractor loader makes a big difference in your output. You clip valuable seconds from work cycles by dumping loads right into the center of high-body trucks. No time-consuming loading from both sides . . . no pitching . . . no wasting time dozing to distribute material evenly—and no banging up truck and loader.

Other exclusive advantages include: *Faster Shifting*—one lever controls both forward-reverse and all speeds. *Greater Stability*—easier loading, less spillage, more operator comfort. *Strong, Pin-Connected Axles* prevent rolling and shifting of axles under load. Your Allis-Chalmers dealer can show you other tractor loader advantages that bring extra production on excavating and loading work. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

TL-20—6 buckets, from 2¼ to 5 cu yd • 130-hp diesel • 23,250 lb • 9,000-lb. carry capacity





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power for a growing world

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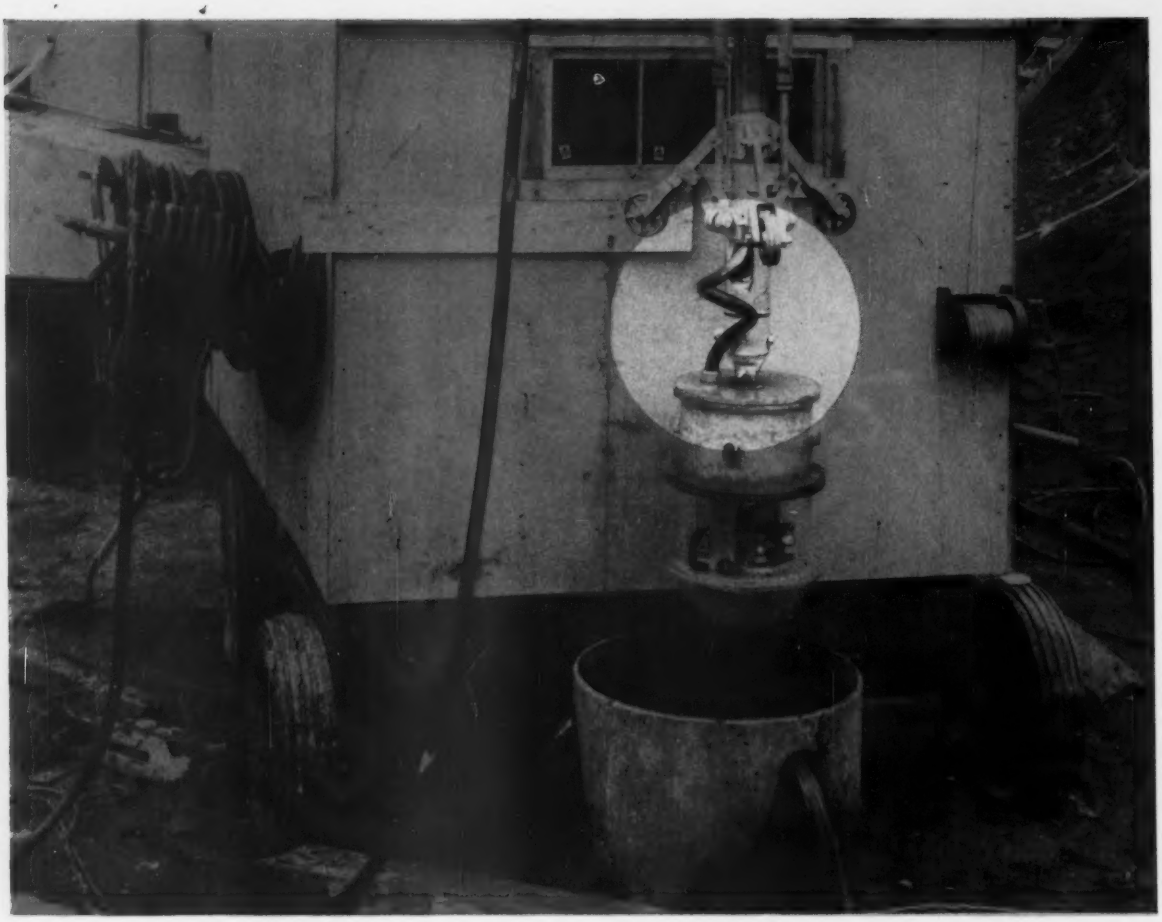

OPTIC NERVE FOR EYES THAT SEE 100 FEET BELOW THE SURFACE

This is a television camera. Its job is to photograph the substrata of excavations, thereby providing information needed by engineers in planning the construction of Boston's new Prudential Center, a modern, multi-million dollar real estate development.

Here in the Back Bay section of Boston, with its artificially maintained water table, this sealed camera must go down into a water-filled hole 100 feet below the surface. To transmit the picture from the camera to the surface monitor, Lake Service Corp. of Brighton, Massachusetts, designers and manufacturers of the television equipment, chose Simplex Anhydrex XX insulated cable because of its ability to withstand the rigors of submarine and direct burial duty.

For all types of service involving high and low voltages, whether aerial, underground or submarine, or for everyday plant wiring, it pays to call a Simplex Engineer.

Simplex BALANCED COMPOUNDING

WIRE & CABLE CO.

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75 Years of Leadership in the Wire and Cable Industry

PERFORMANCE puts another NORTHWEST in VITRO MINERALS pit!

A veteran 80-D handling enormous amounts of overburden at Gas Hills, Wyoming.

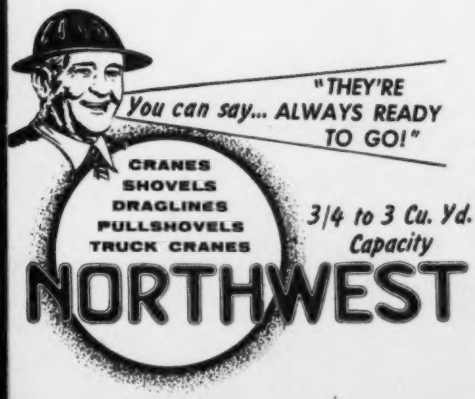
Vitro Minerals Corporation, at their Gas Hills, Wyoming uranium operations, have had long experience with Northwest equipment. A veteran Northwest 80-D Dragline has been removing enormous amounts of overburden to reach the uranium oxide. It was found that the Northwest could remove 20 ft. of overburden profitably for each foot of ore uncovered.

Now there is another Northwest in the pit. A new Model 6 Shovel is bringing all the advanced design and the Northwest advantages developed in recent years.

Here again is a repeat order by another mine that has found Northwest always ready to go — dependable — profitable!

Shovel operation is not measured by the speed of a hoist rope or the number of revolutions per minute. Shovel production is the result of maintained steady month in and month out operation. They are built for the toughest job a shovel has to do. Your Northwest is a real Rock Shovel. The Northwest Dual Independent Crowd that utilizes force most independent crowd shovels waste, combines with the ease of operation that comes with the Feather-Touch Clutch Control, the safety advantages that come with the Cushion Clutch, the smoothness of Uniform Pressure Swing Clutches, the easy mobility of Northwest Crawlers and other Northwest advantages to assure greater output in any kind of digging.

Northwests get the job done. Let a Northwest man bring you up-to-date on the latest Northwest features.



NORTHWEST ENGINEERING COMPANY

1509 Field Building • 135 South LaSalle Street • Chicago 3, Illinois

THIS IS MSA: Illumination · Electronic Communication and Control · Rock Dusting and Dust Collecting · Fire Fighting Equipment · Respiratory Protection · Artificial Respiration Equipment · Personal Protective Wear · First Aid Equipment · Permanent and Portable Instruments

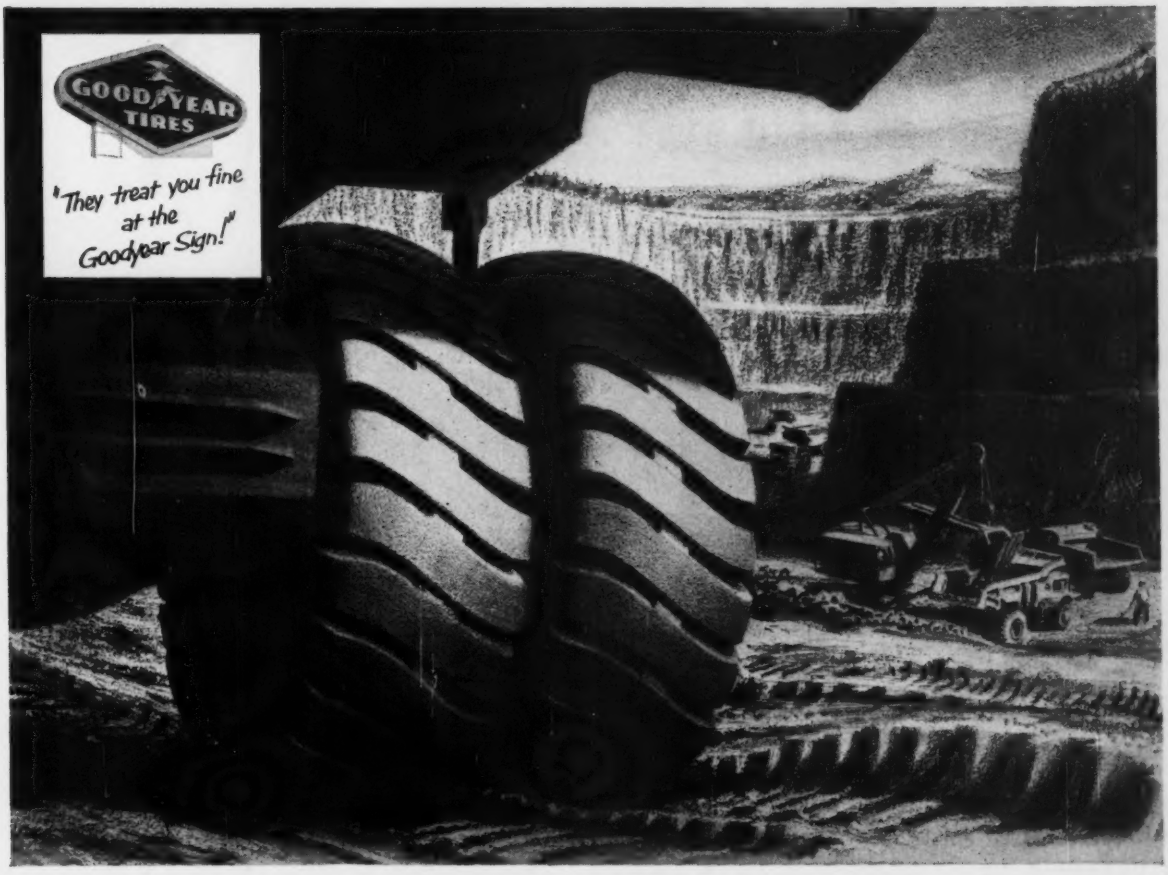
So much depends on unfailing light

Men and machines cannot work at peak productivity without proper illumination. Poor light means unsafe working conditions. Without light there is no work, no production underground. Illumination is *that* important.

Through years of close cooperation with the mining industry, Mine Safety Appliances has developed a quality line of illumination products that put all-important unfailing light underground. And, all MSA products are backed up by a network of sales, service and warehouse facilities.

MSA illumination products include miners' Edison electric cap lamps, permissible trip lamps and fluorescent mine lighting systems. Automatic lamp charging equipment is supplied for self-service lamphouse installations.

Contact your MSA representative for additional information. Or, write Mine Safety Appliances Company, 201 N. Braddock Ave., Pittsburgh 8, Pa. In Canada: Mine Safety Appliances Company of Canada Ltd., 500 MacPherson Ave., Toronto 4, Ont.



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HARD ROCK LUG XTRA TRED

Here it is! From Goodyear's advanced technology and processes—

HARD ROCK LUG XTRA TRED—the mine and quarry tire that's built with extra tread to take it where the going's tough!

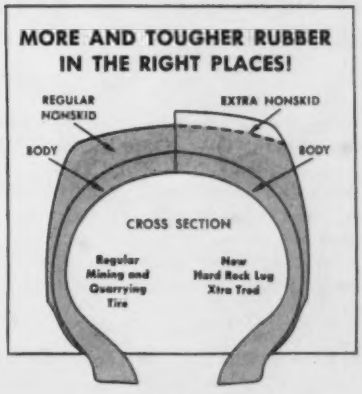
It's made with 3-T Nylon Cord—triple-tempered by Tension, Temperature and Time—that makes *the world's toughest tire bodies.*

It has specially compounded rubber that embodies remarkable super-toughening agents for far greater chip-, wear- and penetration-resistance—that produces *the world's toughest treads.*

And, with its thicker nonskid tread depth (as much as 71% thicker) for harder-biting, longer-wearing lugs, you take out *more pay loads in less time and at lower cost*—with fewer maintenance headaches, too!

Ask your Goodyear dealer about Hard Rock Lug Xtra Treds, *now.*

Goodyear, Truck Tire Department, Akron 16, Ohio.



THE WORLD'S TOUGHEST TRUCK TIRES BY

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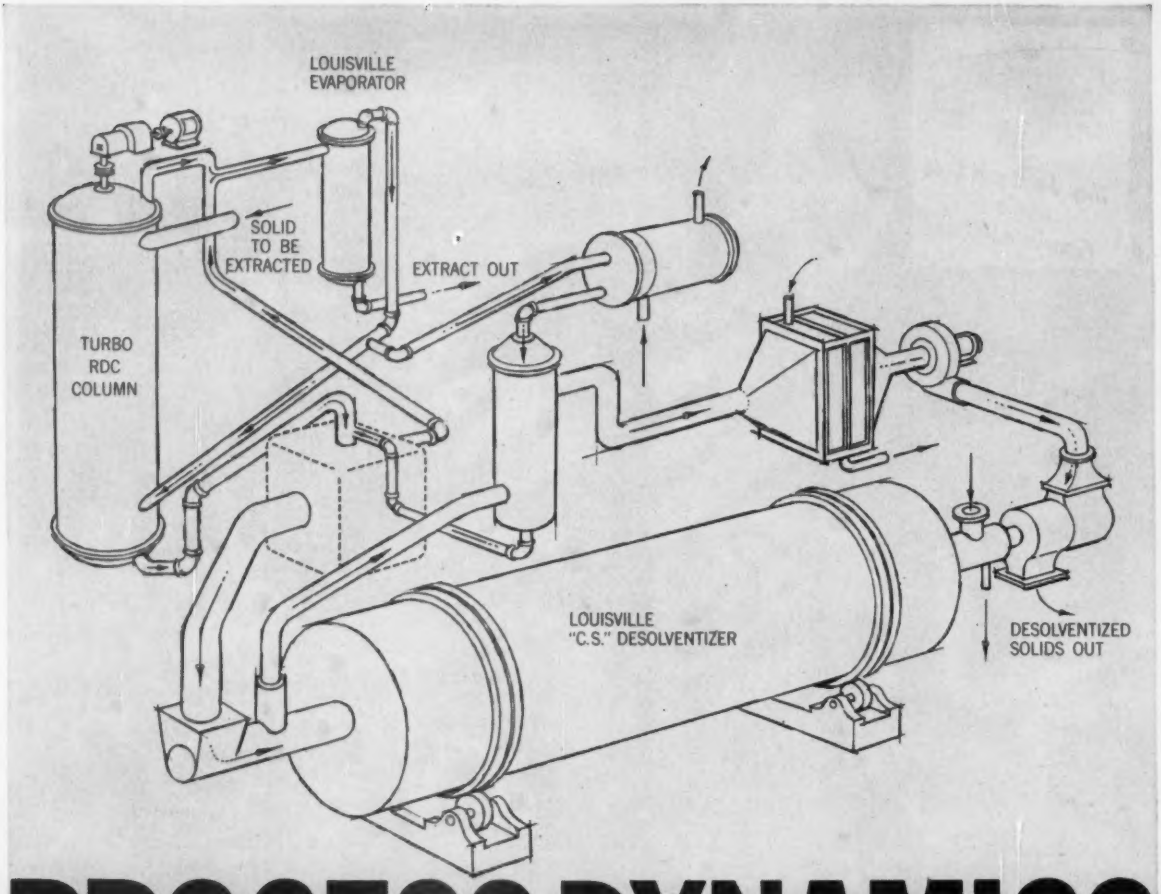
Xtra Tread—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND



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General American's wide diversification permits the design of equipment for *controlled performance* and *process in transport.* This diversification plus specialized experience and extensive laboratory facilities assures you of correct equipment construction and maximum utilization of automated systems.

Our engineers, with their broad experience in equipment and process specialties, are ready to work with yours to provide any of the listed equipment and systems, and to install them anywhere in the world.

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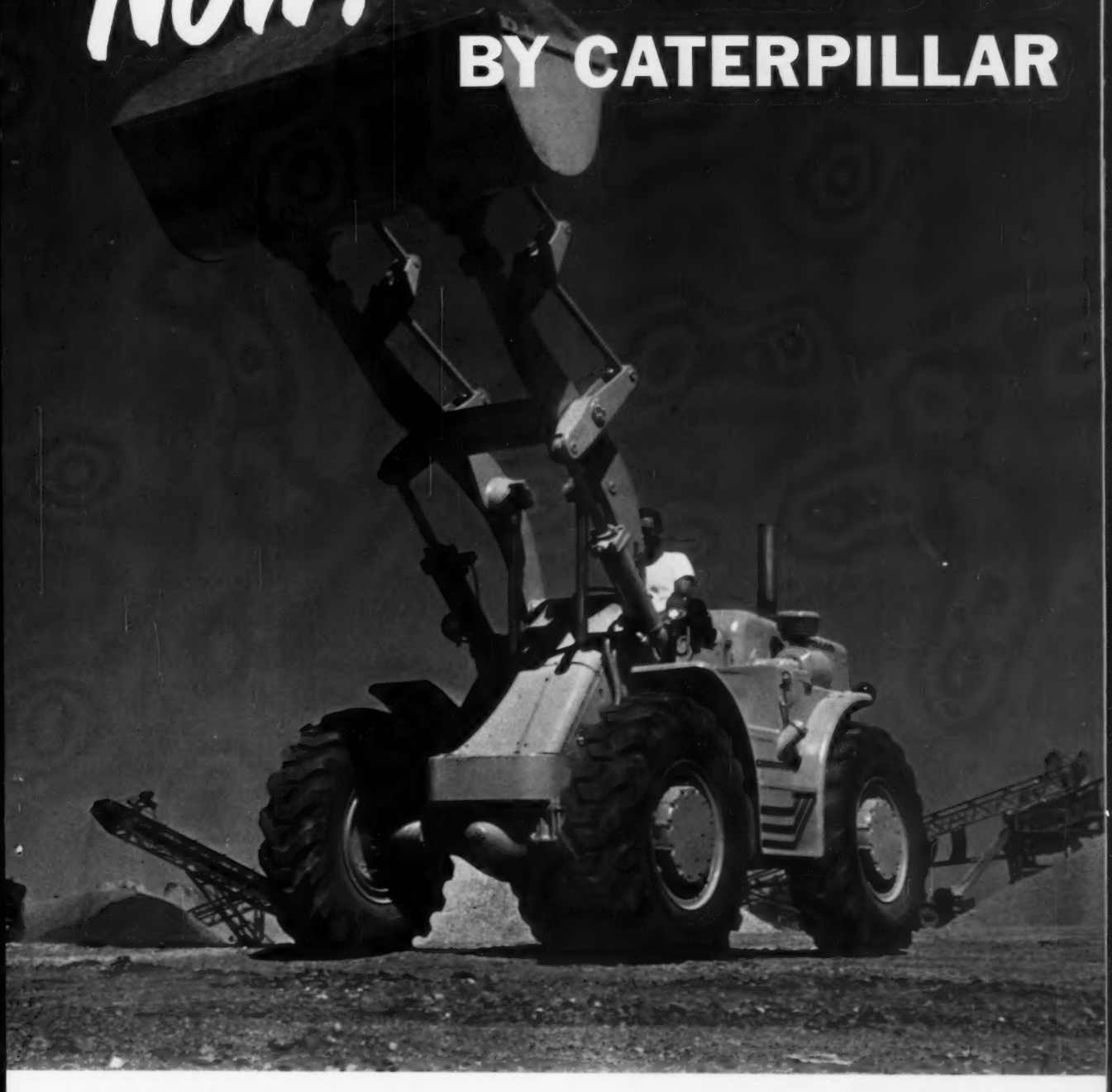
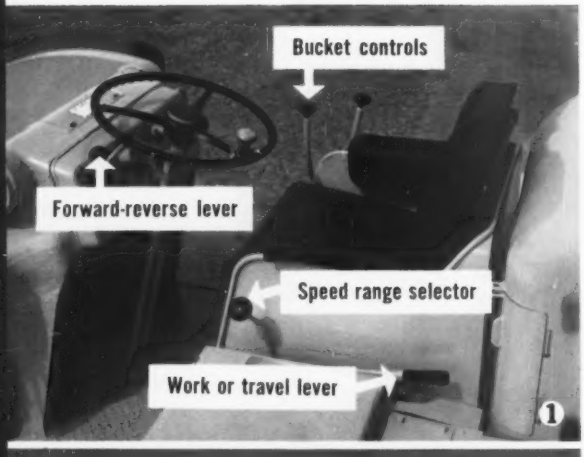
NOW! the No. 944
BY CATERPILLAR



THE *FIRST*
OF A NEW WHEEL LOADER LINE

the No. 944 ...designed for action,



IT'S HERE . . . the Cat No. 944 . . . rated at 2 cu. yd. capacity . . . the first of a completely new line of equipment that will soon include the No. 922 (1¼ cu. yd. bucket) and the No. 966 (2½ cu. yd. bucket).

Watch for these new machines with the bold new design . . . they're ready to bring new standards to wheel loader operation.

Take a look at the No. 944's big, new features . . . features that give it lively response and make it the easiest and safest wheel loader to operate. See it in action at your Caterpillar Dealer. Ask him for a demonstration. See for yourself how the *new design* pays off on your loader jobs.

DESIGNED FOR ACTION . . . with plenty of power for both machine drive *and* bucket hydraulics. Choose from two great, new engines . . . the compact 4-cylinder diesel, turbocharged for maximum efficiency . . . or the 6-cylinder gasoline engine. Both are 105 HP units, fully equipped. Both are made to the same rigid standards. Whatever the requirements of your operation, there's a No. 944 powered to meet your needs.

Tailored to this power is the torque converter and power shift transmission, providing smooth, instant, finger-tip shifting. A full range of work and travel speeds is available on the No. 944. And reverse speeds are 25% faster than forward speeds . . . important in reducing cycle times. Travel Range gives 2-wheel drive for roading . . . Work Range automatically puts power to all 4 wheels.

Machine and bucket controls are located for easy handling**(1)**—the forward-reverse lever is mounted on the steering column.

Both bucket control levers have kick-out devices. The lift control releases at dumping height—the tilt control positions the bucket for digging. And for full bucket loads every pass the 2 cu. yd. bucket tilts back 41° at ground level. The high lift and *extra-long reach* make truck loading faster, easier.

There's plenty of action designed into the No. 944, ready to speed up your loader jobs.

DESIGNED FOR SAFETY . . . in the bold new lines**(2)**. Bucket lift arms and pivot points are completely in front of the operator's area. This gives the operator new freedom of movement . . . greater all-around visibility.

Wide steps**(3)** make it safe and easy to get on or off . . . from either side. No need to climb over tires. Fenders provide a handy platform for checking the engine and they protect the operator from rocks and mud**(4)**.

The No. 944 brake system gives safer, more precise control**(5)**. The *left* brake neutralizes the transmission *as* it stops the machine. This gives superior loading action in extra-tough material.

Traxcavator safety, economy

The *right* brake leaves the transmission engaged . . . for full control when creeping, working on steep slopes or roading downhill.

These and other safety-bonus features give the No. 944 operator greater confidence, greater efficiency.

DESIGNED FOR ECONOMY . . . in the Caterpillar tradition. Sound engineering, modern design, service accessibility, quality construction, responsible parts and service coverage all add up to a new kind of stability—mechanical stability—in the No. 944. The many cost-saving features of this NEW wheel loader will pay off big in your operation!

Offered in a full line of versatile attachments and accessories are forks, cab(**6**) and special buckets, including the *exclusive side dump* that gives the No. 944 added efficiency.

BRIEF SPECIFICATIONS

Horsepower (Net)	105*
Bucket capacity	2 cu. yd.
Bucket reach (@ 7 ft. dump height)	50¾ in.
Over-all width (bucket)	93½ in.
Wheel base	88 in.
Speeds, forward (4)	0-24 MPH
reverse (4)	0-30 MPH
Weight, shipping (with diesel engine)	20,780 lb.
(with gasoline engine)	20,440 lb.

* For comparative purposes, the maximum rating of the D330 Engine used in the No. 944 is 135 horsepower.

THE No. 944 TRAXCAVATOR...

NEW IN DESIGN AND
LOADED WITH PERFORMANCE

Learn more about it. Visit your Caterpillar Dealer the week of March 14

There's a wealth of LOADER KNOW-HOW behind the No. 944. It comes from the builders of the best accepted track-type tractor-shovels in the field.

Every feature is designed for *efficient work*. Plenty of horsepower . . . finger-tip shifting . . . smooth, fast bucket action . . . outstanding operator comfort and safety. The result is the bold, new No. 944 . . . the *outstanding* performer in its class!

For complete facts, see your Caterpillar Dealer now.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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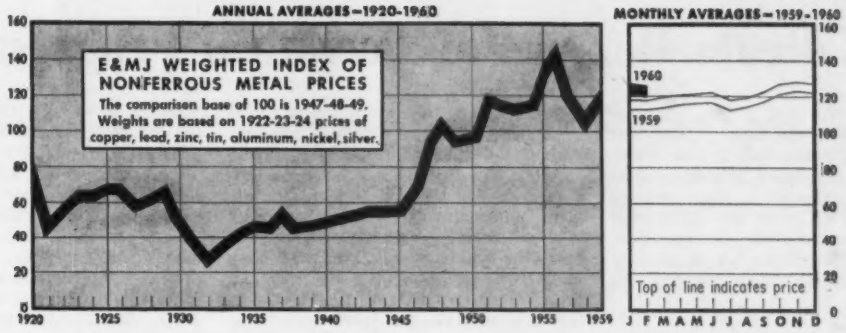
PRICES



MARKETS

E&MJ's nonferrous metal price index continued to decline during February, dropping from 127.8 for January to 126.6 for February. A 1.7c dip in copper prices accounted for the decline.

●

AT HOME

Uranium available in the U.S. at present prices will support the projected U.S. nuclear industry beyond the year 2000, according to Dr. Chauncey Starr, general manager, Atomics International Division, American Aviation, Inc. He said that if the same considerations are applied to world requirements and resources, the present prices would satisfy world needs well after the year 2000.

More than 1,000 companies are pushing accelerated research programs to develop new thermoelectric applications. Sensational discoveries in electronic heating, cooling and power generation are expected to revolutionize the aircraft, automobile, metallurgical, refrigerating, heating and appliance industries during this decade. Forward-looking metal companies are appraising the impact which this new development will have on metal requirements. Large investment groups are getting set to shuffle their long-term portfolios to take advantage of expansion which companies entering the new field will experience. One casualty could be the piston engine, either through thermoelectric discoveries or development of the fuel cell, now well on its way toward limited commercial application.

The Atomic Energy Commission purchased about $2.5-billion worth of uranium concentrates from private sources in the 12 years prior to July 1959. AEC estimates that purchases of U_3O_8 during the next several years will be in excess of $500-million annually.

●

LABOR

International Union of Mine, Mill and Smelter Workers announced that the Teamsters Union, the nation's largest, has pledged aid to Mine-Mill in the court battle over labor law conviction of nine present and past leaders in mine mill. March 14 has been set for argument on three post-trial motions seeking to reverse the convictions.

●

ABROAD

International Iron, Inc., Houston, Texas, has announced the discovery of several major iron deposits on the West Coast of Nicoya Peninsula, Costa Rica. Large deposits of medium and high-grade magnetite and hematite are reported.

Indian Aluminium Co., Ltd., associate of Aluminium, Ltd., plans to increase ingot capacity from 11,200 tons to 22,400 tons at the Hirakud smelter in India. Cost of the expansion program in bauxite production, alumina, aluminum ingot and rolling mill, and extrusion facilities will total $17-million. Part of the program will be financed by an Export Import Bank credit to the Government of India.

Japanese inventors have patented a concentrating device that separates mineral particles through the combined use of the gravitational and magnetic forces. Ground ore is fed to a tilted oscillating table operating in an ac magnetic field. The item is described in British Patent Specification 826,485.

THIS MONTH IN MINING

AIME Hears Reports of Technical Progress

THE ANNUAL MEETING of the American Institute of Mining, Metallurgical and Petroleum Engineers, held in mid-February in New York, heard industry leaders list areas of progress in their various fields, learned of some new equipment for new use in the field of exploration, and elected new officers for the year in the three societies which compose the institute.

W. T. Swensen, assistant vice president of Anaconda Co. (Canada) Ltd., in one of the papers presented at the technical sessions, described the iron orebody (mostly magnetite) which his firm has opened and partially developed in north central Ontario. Two main deposits of higher grade ore are estimated to extend well below a depth of 400 ft, Swensen said, and low grade iron ore has been found throughout. The first body, the Briarcliffe, is 100 to 150 ft wide and over a mile long. The Two Mile Lake deposit, one mile wide and 250 to 400 ft thick, is "amenable to open pitting for an east-west distance of several thousand feet. Its further extension has been indicated for at least three miles by magnetometer work and diamond drill tests."

Savings in compensation costs in the 1955-1958 period at Chino Mines Division, Kennecott Copper Corp., over the previous 10-year period of about $60,000 per year were attributed by Paul L. Hunter, safety director. "We stress that safety is efficiency," Hunter said, and noted that the estimate did not include medical expenses, damaged equipment, loss of production or overtime replacement costs. He also prescribed more rigid hiring requirements.

"Magnetic roasting" of hematite ores from Minnesota was the basis of a paper by associate professor Gust Bitsianes, of the University of Minnesota Mines Experiment Station. "The most suitable reactor," according to the author, "will be a traveling grate, on which a bed of crushed hematitic ore will be subjected to the action of a preheated and reducing gas stream," so that a maximum amount of magnetite is formed.

Tighter control of temperatures at the Jones & Laughlin basic oxygen steel plant at Aliquippa, through a mathematical model of required scrap, lime and hot metal additions has proven so successful that the firm will now install an electronic computer to facilitate the equations, which are, in turn, a product of thermochemical analysis. The paper on the results was given by W. J. Slatosky, research physicist for J&L.

A dry separation technique which worked in rock salt may "open the way to a number of practical processes" for minerals and metals, according to Oscar F. Tangel and Robert J. Brison, minerals beneficiation division, Battelle Memorial Institute. The method is based upon separation in which "one or more components transmits or reflects radiant heat to a greater extent than do other components," the authors said. For conducting materials, induction heating may be used; for non-conductors, dielectric heating may be applicable. In the process as used at International Salt Co., impure particles in crude rock salt heat selectively under radiant heating and adhere to a heat-sensitive coating on a conveyor belt.

Columbium resources of the world, according to K. C. Li, president of Wah Chang Corp., total 750,250 tons (Cb_{205}) for North America; 6-million-plus tons for South America; Europe, 20,100; Africa, 1.6-million; and Asia 1,000. In his paper, Mr. Li also discussed the liquid-liquid separation technique of recovering the mineral and followed columbium technology through to the consolidation and purification steps, with the electron beam and arc casting methods. In his statement, Mr. Li also discussed the future of the metal and announced the recent discovery of a huge deposit of approximately 7.5-million tons of contained columbium in Araxa, Minas Gerais, Brazil. "A unique and simple mechanical process," according to Mr. Li "has been discovered for milling the ore to a grade of over 70% Cb_{205}."

James F. Boyd, president of the Mining and Metallurgical Society, which met during the convention, took his organization to task for its less positive role in recent years as a force for support of Government and public programs which would represent improvements in the mineral industry. He took note of the diversity of objectives within the industry itself (see Washington Impact, p 24) and noted that Congressional hearings have not heard the industry present a unified position and thus have not been able to act to satisfy the problems. The Kennecott vice president said, "This is one area where we should rise to the heights of statesmanship . . . we should be able to say to ourselves that what is best for the nation is best for the industry as a whole. . . ."

Ferronickel production at nearly 25% above design capacity was reported from the Hanna Nickel Smelting Co. smelter by E. E. Coleman, plant manager at Riddle, Ore., and D. N. Vedensky, of Cleveland, Hanna vice president. The Ugine process, the authors said, has proved satisfactory and economical at Riddle, "the first time the process has been used for large scale, continuous operation." Silicon is the reducing medium at Riddle, where it is added to molten ferrous metal as 45% ferrosilicon and the mixture agitated by pouring rapidly from ladle to ladle. The exothermic heat of the reaction assists in maintaining high tem-

Asarco Strips Mission, Plans $17-Million Mill

OVERBURDEN stripping has begun at American Smelting & Refining Co.'s new Mission Project, on a porphyry copper deposit 15 miles southwest of Tucson, Ariz.

Production is expected in early 1962 from the $43.5-million plant, which will include a $17-million concentrator for 15,000-tpd ore throughput. Some 45,000 tons of metal per year will be the final product, with concentrate going from the Western Knapp Engineering Co.-designed mill to Asarco's Hayden, Ariz. smelter. Mill construction was to begin March 1, with completion due in September 1961.

perature during the reduction cycle.

New officers for 1960 were installed at the annual meeting. Dr. Joseph L. Gillson, chief geologist of Du Pont became president; and Ronald E. McNaughton, manager of Cominco's metallurgical division, became president-elect. The Society of Mining Engineers elected Arthur B. Cummins, manager of central research for Johns-Manville president and James C. Gray, administrative vice president-raw materials, U.S. Steel, as president-elect, and H. Carroll Weed, general manager of Inspiration Consolidated Copper Co. as vice president. Metallurgical Society officers include: Dr. Carleton G. Long, director of research, St. Joseph Lead Co., president; J. S. Smart, Jr., general sales manager, Asarco, president-elect; and 1960 term vice president.

New directors of SME include Prof. Nathaniel Arbiter, of Columbia's School of Mines; Sanford S. Cole, assistant manager of research, National Lead's titanium division; Donald A. Dahlstrom, research and development director of Eimco; Dean Charles F. Park of Stanford University; Raymond D. Satterley, general manager of ore mines for Inland Steel; and Prof. Ernest M. Spokes, department of mining engineering, University of Kentucky.

Metallurgical Society directors include Prof. A. W. Schlechten of Rolla (Missouri School of Mines); Reinhardt Schuhmann Jr., professor of metallurgical engineering, Purdue; J. H. Scaff, metallurgist with Bell Telephone; Thomas A. Read, head of the mining and metallurgical engineering department, University of Illinois; Karl L. Fetters, vice president of Youngstown Sheet & Tube; and John J. Golden, assistant to the administrative vice president, U.S. Steel.

At the MBD session, Carl Rampacek, supervising metallurgist, and W. A. McKinney, extractive metallurgist, USBM Tucson metallurgy research laboratory, said that the copper segregation process is applicable to the treatment of oxidized and mixed oxide-sulphide copper ores regardless of the gangue constituents. Ore is heated to 750°C with sodium chloride and coke to produce metallic copper which is then recovered by flotation.

R. D. MacDonald told the mining and exploration division that the gravimetric method of geophysical prospecting is capable of locating magnetic and non-magnetic iron deposits in drift covered areas. He noted that once rock densities are known, the method will give a fairly accurate estimate of the ore volume.

Correction

The beryllium firm of Northwest Defense Materials, Inc. of South Dakota, was incorrectly identified in the headline on p 172 of the February 1960 issue.

As We Went to Press . . .

Production from the long-studied Bathurst lead-zinc mine of Brunswick Mining & Smelting Corp. may be forthcoming following an agreement "in principle" between Brunswick and Sogemines Ltd. St. Joseph Lead Co. holds 40% ownership of Brunswick and has management responsibility for the mine.

The agreement reached by the two companies calls for initial production of 2,000 tpd and expenditure of $17.5-million. The mine is near Bathurst, N.B., on Chaleur Bay.

A 15-year contract to sell concentrates from the mine to Belgian base metal smelters is a part of the preliminary agreement.

Discovery of a huge columbium ore deposit in Araxa, Minas Gerais, Brazil, has been announced by K. C. Li, president of Wah Chang. Mr. Li, who also spoke at the annual meeting of AIME, in New York, (see left) said that approximately 7.5-million tons of contained columbium was present in the deposit, which could be milled to plus 70% Cb_{205} by "a unique and simple mechanical process."

Pittsburgh Steel Co. announced plans to expand its ore supply from ownership-interest mines, including an open pit property in Newfoundland. President Allison R. Maxwell noted that the firm has previously obtained only about 40% of its ore from partnership mines and purchased the remainder. With the new program, which consists of the Labrador mine and other development, Pittsburgh will raise the percentage to 70%.

Discovery of a 7-million ton asbestos deposit in the Ungava region of northern Quebec was announced by Mines Minister William Cottingham. Murray Watts, of Toronto, said his firm will drill some 20,000 ft on the property in 1960 and conduct extended surveys on the site. The Watts firm drilled 4,000 ft in 1959. (See Quebec.)

A new mine may be forthcoming in the Northern Free State of South Africa. A borehole at Western Holdings prospecting area, one of the Anglo American mines in OFS, showed high values. Officials emphasize that further drilling is necessary.

Construction of a $40-million sulphur and steel complex is to begin June 1 in the Lake St. John area of northern Quebec, according to Sulphur Converting Corp.

The firm, which has German financial backing, will process iron pyrites mined at Bear Bay in the Chibougamau area and produce sulphur and, subsequently, steel products. Production is due about four years from start of construction, according to J. A. Leclerc, president.

Robert M. Hardy, 77, former president of the Sunshine Mining Co., died Feb. 21 at his home in Yakima, Wash.

Mr. Hardy, a graduate of Louisiana State University, went to the Pacific Northwest in 1906. He became active in the Sunshine Mining Co. in the mid-1930's. The company has since expanded into one of the nation's largest producers of silver.

His son, Robert M. Hardy Jr., is president of the Sunshine Mining Co.

WASHINGTON IMPACT

Highlights

MINE AID HOPES DIM—Prospects for any significant new import protection or subsidy support for domestic metal-mineral mines are fading fast on Capitol Hill. Indications are that the Administration will substitute slightly higher tariffs than now apply. As for Congressional attempts to legislate significantly higher tariffs or subsidies, a Mining Bloc effort to rally dissident segments of diverse industry interests is still being pushed, and spokesmen for domestic producers cling to the long-shot bet that at least one of several legislative proposals for new Government aid may gather enough election-year votes to put it across. But time is running out in a short Congressional session, and insiders already are close to admitting defeat.

The result is that western and southern mining-state Congressmen are finding themselves more involved with form than substance of the various efforts that are being made, more concerned with building a record for possible future action than with specific issues this year.

The hottest fights in Washington over Federal metal-mineral policy —tariff protection, price or production subsidy proposals, stockpile disposal policy—are falling into the pattern.

LEAD-ZINC IMPORT TEST—Tariff Commission's key study of the state of health of domestic lead and zinc industries will be completed this month, with "specific finding of fact" due to be reported to Congress by March 31. As this issue of E&MJ went to press, it was still an open question as to what stand the Commission will take. Domestic producers were hoping it would provide some ammunition for higher import duties, if not an extension and expansions of existing import quotas.

They have some support in this hope from international producers, smelters and processers, who oppose the current quotas, but are willing to support higher duties instead. The problem, according to Congressional and Commission sources, is that the divergent interests within the loosely-knit domestic industries have so far failed to get together on what the tariff boost should be. Small strictly domestic mines are holding out for a minimum rate of 3c per lb on lead and zinc ores and concentrates. International companies and processors are unwilling to fight for a duty boost which would set rates at more than 2½c.

While this difference seems small, the key point is that larger interests fundamentally are against even a boost to 2½c, and domestic mines sincerely feel 3c is too low. The fact is that the companies involved are reluctant to compromise as much as they have already, and draw the line at giving in on the final ½c.

It is this situation which has Mining Bloc Congressmen on Capitol Hill throwing up their hands in despair. New legislation to increase import protection will be introduced, regardless of what the Commission report recommends or the White House does on its own. Any chance for passage in face of lack of unified industry support is regarded as nil.

SUPPORT LEGISLATION—On another front, or series of fronts, the Mining Bloc is also having trouble getting industry lined up behind a drive to legislate new Administration programs which would support the price or production levels of small domestic mines. A rash of bills has been introduced in the Senate and House, and if domestic producers of a long list of minerals can agree on a single formula for price or production subsidies, some mining-state legislators are now saying this offers more hope than legislated tariff protection.

THE INDUSTRY SPLIT—Even the American Mining Congress has been affected by the differences of approach of member companies. Coal producers have backed a proposal to legislate a new national fuels policy. Hard-rock miners have backed a move by Senate and House Interior Committee Chairmen James Murray (D—MONT.) and Wayne Aspinall (D—COLO.) to push blanket minerals policy legislation. According to Congressional experts, coal interests first wooed domestic mines on the grounds that both groups wanted to restrict competing imports, then lost the support of metal mining state legislators by insisting on their fuels policy legislation without cooperating on mining policy legislation. The result, say informed sources, is that neither proposal will win enough backing in the current short session to pass.

Quotas Seen Expiring; Mild Tariff Rise Likely

THE LEAD-ZINC tariff fight has now boiled down to this: with domestic producers, international companies, smelters, processors and importers all opposing a continuation of existing import quotas on lead and zinc ores and concentrates, the days the quotas remain in effect are numbered. It is unlikely that they will be removed by the Administration without somewhat higher import duties being imposed in their place. The question is how great these increases in present tariffs should be, and whether they will be put into effect by the White House or through Congressional legislation.

Small domestic producers, of course, would like to see the quotas expanded and extended. But they would prefer higher tariffs to a continuation of the present quota rates.

Importers want the quotas removed without any subsequent duty increase, but they recognize this as a virtual political impossibility in an election year, and regard slightly higher tariffs as the lesser of two evils.

International companies, and domestic processors and smelters want both higher duties and a removal of the quotas—a sort of compromise between protection and freer trade.

The big question is what compromise can be found that will be acceptable to the several diverse interests involved, and how it will be worked out. Domestic processors and international producers have indicated to Congressional sources that they would approve increases in the present ¾c per lb rate on lead ores and concentrates, and 3/5c on zinc to as much as 2½c per lb on each. Domestic miners, who have asked as much as a 4c tariff on each metal in pending Congressional legislation, have indicated they would compromise at 3c. Importers want the new rate to be no more than 1½c on each. Rates on semi-finished and manufactured forms and products, of course, would run higher.

Given this apparent impasse within the diverse segments of the lead-zinc industries, the problem facing the White House, the Tariff Commission and Congress is how to handle a compromise even assuming one is worked out.

The Tariff Commission, probably on a split vote, will make "specific findings of fact" to Congress this month under its pending Section No. 332 investigation. The Congressional Mining Bloc will then attempt to push tariff-boosting legislation, and try to mount a unified drive behind production or price support subsidy legislation as well. The White House, meanwhile, will have its crack at removing quotas next fall.

But there are serious legal questions that complicate the picture still further. Importers have challenged the Commission's constitutional right to make any

"specific" recommendations under Section No. 332. The Commission has asked Congress to define what it means in ordering the current study by its language asking the Commission to determine what is needed to maintain domestic lead-zinc industries on a "sound and stable basis." In a formal reply last month, Senate Interior Committee chairman James Murray (D-Mont.) quoted from the Administration's mineral stabilization bill sponsored by Interior Secretary Fred Seaton and defeated in the last Congress, which set 14¾c as the desirable domestic price per lb. and 12¾c on lead and zinc respectively

The final upshot of this complex situation is likely to be that the White House will substitute some tariff increases on lead and zinc for current import quotas next fall—not soon enough to please some zinc users who say they are facing a growing market shortage this year. No one knows how much the new rates will be raised.

The White House obviously is caught between election-year pressures from domestic producers on the one extreme, and Latin American suppliers it is trying to woo in the framework of its Good Neighbor and liberal trade policies on the other. Best bet is that the ore and concentrate rate will be set at close to 2c per lb. This would reasonably satisfy international companies and processors, and be more acceptable to foreign suppliers than it would to small domestic mines.

Technicalities Hamper Mine Aid Legislation

OTHER FEDERAL mining aid legislation aimed at setting up new support programs for a long list of nonferrous metals and minerals is also bogged down in a swamp of technicalities (see above). Several dozen bills have been introduced in this session of Congress to provide production bonuses, price supports, incentive purchase programs, or at least a formal new Administration "mining policy" for small mines.

But an example of the trouble these are running into cropped up late last month, when the Interior Department replied to the so-called Aspinall resolution calling for an Administration review of all its mineral programs by asking Congress again what it meant when it directed the executive branch to consider additional measures to keep domestic production "sound and stable." The Congressional Interior Committees will also refer back to secretary Seaton's previous stabilization bill—which set certain production and price levels as required domestic goals.

But the Administration has already made it clear it will not initiate any new mine support legislation this session. This puts the onus on Congress to rally diverse segments of domestic mining industries behind a single support bill—a long-shot bet at best in a short Congressional session.

Labor This Month

LABOR-MANAGEMENT SUMMIT NEARS: Despite active resistance by some employer groups, the prospects are growing for peace forums of top union and business representatives. The Eisenhower Administration—through Labor Secretary Mitchell—is pressuring both sides to sup at the same table, away from their negotiating contests. The goal is to break down animosities aroused during the tough 1959-60 strikes. The six-month nonferrous mine strike involving Mine-Mill and Smelter Workers and the 116-day strike by the United Steel Workers has Federal officials warning it can't happen again.

George Meany and other labor leaders are backing the peace plan. But many employers, and such organizations as the Chamber of Commerce and National Association of Manufacturers are wary. They feel management has come off second best in all such meeting in the past. However, Mitchell has new ideas. The Administration would step out, once the parties got talking. And the subject matter would be mutual aims, not bargaining differences.

"WHERE DO WE GO FROM HERE?" AFL-CIO organizers now admit to being stymied over the past five years, ever since the merger of the labor federation. Blunt reports from AFL-CIO organizing director John W. Livingston to the federation leadership disclose no net gain since 1955. The AFL-CIO membership still totals 13.5-million, mostly because rival affiliated unions can't agree on splitting up non-union territory.

Livingston warns—unless the federation changes its organizing methods, unions will fall farther behind the unorganized bloc of workers. The old method has been for AFL-CIO organizers to stay out of disputed territory, such as nonferrous mining, chemicals, textiles and petroleum. For instance, where the Steelworkers and metal trades unions conflict over Mine-Mill territory, the federation's own organizers are barred from helping. Now Livingston urges the AFL-CIO to move in.

A MINE STRIKE POSTSCRIPT: When the Mine-Mill and Smelter Workers Union settled its 177-day strike via a new three-year agreement with Anaconda Co., it was with mixed blessings at the union's international headquarters. Although the agreement ended the record six-month copper strike, Mine-Mill spokesman Sam Feldman concedes it took a severe crimp in the union treasury. "It became," he says, "a situation where there was nothing else to do but settle at the company's price."

LABOR LEGISLATIVE SIGHTS RISE: The trouble predicted for union goals in Congress has begun to fade. After last year's losing battle over the 1959 reform law, labor lobbyists cautiously approached the second session of the 86th Congress with two key demands: a higher and broader minimum wage and a change in the Taft-Hartley law to lift the picketing ban on construction projects. Labor Secretary Mitchell now is backing both moves. This is expected to add enough Republican votes.

OUT OF THE FRYING PAN: House Labor Committee chairman Graham Barden's decision to quit Congress this year removes a major bottleneck to labor hopes for a big legislative drive in 1961. Barden, a North Carolina Democrat, has effectively blocked dozens of union bills in his 10 years as committee leader. However, his successor, liberal Democrat Adam Clayton Powell, may be much more difficult to deal with than anticipated. AFL-CIO president George Meany calls Powell a "terrible" Congressman. Union staff lobbyists, who must deal with Powell, cringed at Meany's description. All AFL-CIO proposals must go through his hands on the House side.

HIGH COURT OKAYS SLOWDOWNS: When a union is involved in bargaining with management, it can simultaneously pressure management by slowdowns, harrassing tactics and other "economic pressure devices." This is the recent ruling of the U.S. Supreme Court, which found such tactics—in a 1956 case involving agents of the Prudential Insurance Co. —permissible under the Taft-Hartley Law. That these tactics come under the Law's definition of good-faith bargaining is the decision.

MARKETS

Most Copper Strikes Over; Prices Easier; Zinc Firm; Mercury Strong

NONFERROUS METAL PRICES in February dropped slightly. According to the E&MJ index the February average was 126.6% of the 1947-'49 average; January was 127.8%. Only copper dropped in price but this more than offset the increase in the monthly average zinc price to 13c from 12.877. Tin increased from 99.888c to 101.00c per lb.

Struck copper properties became fewer in February. Kennecott settled with three craft unions at its Utah mine and mill. Phelps Dodge settled all its strikes except at the Laurel Hill refinery. Anaconda and Mine-Mill settled at Butte, Great Falls and East Helena. The White Pine strike was ended. At the end of the month only the Phelps Dodge Laurel Hill refinery in New York remained out. Negotiations were being held with the United Steelworkers and many felt the strike would be over soon.

The activation of mining properties could be seen in the January Copper Institute figures. Crude primary output in January was 65,061 short tons; not since July of 1959 had it been this high. There had been a slight pickup in December. There will be a much greater increase in February. In March mine output will again be "normal."

Refined copper production also picked up in January in the U.S. It was 86,491 short tons, 40,000 above December. August was the last preceding month when this much copper was refined in the U.S.

Deliveries to fabricators in the U.S. rose to 104,678 tons in January. Deliveries outside the U.S. were 160,772, the highest on record except for August 1958. World refined copper stocks held by sellers dropped 10,437 tons in January but blister stocks rose by 2,447 tons more than this. Sellers' copper stocks have hardly changed in the past three months.

Copper prices eased. London prompt bid was £266 February 1; on the 29th it was £257½ (32¼c per lb). It had reached a high of £276½ February 9.

Merchant prices in the U.S. dropped. In part this followed from the drop in Europe—merchants could get it cheaper. But it also reflected the easier demand in the U.S. Buyers felt they could wait—many thought that they would be getting 33c copper from the producers. Some were already getting it. Others knew they would be getting some in March and many felt by late March there would be "no copper shortage."

A number of buyers put the big question: "When will the smelter price of 35c be dropped?" Some pointed out that there were actually a number of smelter prices and that the easing situation had already cut them.

About the first of February Asarco reported the first shipment of blister arrived from Southern Peru Copper at its Baltimore refinery. It said other shipments were in route.

Reports appeared that Kennecott was contemplating increasing, possibly doubling, its output of copper in Chile.

Zinc sales in February in the U.S. were slow. Most sellers had expected this owing to the exceptionally heavy sales in early January. January sales had been more than twice "normal." So sellers predicted zinc sales need not be normal again until late March.

Zinc Institute data for January showed the strength in the zinc industries. Heavy shipments knocked stocks down about 10,000 tons in the U.S.

A summary of the December, 1959 and January, 1960, American Zinc Institute statistics in short tons, follows:

	Dec.	Jan.
Stock at beginning	176,157	154,419
Production	69,666	73,326
Production, daily rate	2,247	2,365
Shipments:		
U.S. Industry	84,498	79,325
Export and drawback	6,906	3,949
Totals	91,404	83,274
Stock at end	154,419	144,471

Shipments of Special High, the grade used in die-casting, remained high but under the December figure. Prime Western, the galvanizing grade, was almost unchanged from December's 51,980 short tons.

Japan's Ministry of International Trade and Industry said the country will produce 181,050 tons of zinc metal in 1960, up 15,000 from 1959. It will import 2,500 tons according to this report.

Lead sales in the U.S. were slow in February. This largely followed from the exceptionally heavy sales in January. Some sellers say that inventories will need to get back to the pre-January level before buying will move up. Some indicate that bearish talk has caught on and that buyers are now not afraid to let their stocks drop.

Secretary of the Interior Seaton said the U.S. will maintain lead and zinc import quotas. His statement was sharply critized by Simon Strauss, vice-president of Asarco. Strauss said it was a "prejudging of the findings of the Tariff Commission." He said one custom smelter had already been forced to suspend operations because of the quotas.

The Interior Department had refused just before to take a stand on subsidy legislation—some felt Seaton's statement might offset some criticism from Western Congressmen on this. It may also have been related to UN remarks about the U.S. quotas. The UN had also recommended that restrictions on lead output be maintained but said that those on zinc could be removed.

Reports from Washington were that the Tariff Commission was uncertain what the Senate meant by a "sound and stable" domestic lead and zinc mining industry. The Senate had asked the Tariff Commission to make a recommendation; hearings were held in January and the report is expected in late March.

The strike at the Anaconda Tooele lead smelter was ended. Production will start by early March.

Aluminum sales have been slow during the first two months of the year some producers report.

Alcoa announced it had paid $9-million to Aluminium Ltd., the Canadian producer, in order to rescind a term contract under which it would have received in 1960 and 1961 about 59,000 tons of aluminum worth about $30-million. About 20,000 still remain on the contract.

The payment figures out at about 7.6c lb. The market price is 26c and with the import duty of 1.25c and some freight Aluminium would have realized a gross of about 24c a lb. Some factors said the payment of $9-million appears low. It seems to assume a cost of about 16.4c which most analysts say is high.

Alcoa earlier had indicated the 150,000 ton smelter it was building in the mid-West will start production in June.

Aluminium Ltd. said in Montreal its Indian associate, Indian Aluminium, will expand its facilities for bauxite, alumina, metal, rolling and extruding. Its metal capacity will be raised 11,200 tons.

The N.Y. mercury market rose to $213-16 per flask from $211-13 a month ago. A general firmness hit the market early in the month when a leading California mine, which had moved good quantities of metal at bargain prices during the December-January lull, contracted for its entire output with a leading Eastern refiner.

An absence of spot European and Mexican metal kept ready supplies down as the month progressed. Italian and Spanish sellers were unhappy with low prices, and sellers of Mexican were forced to seek richer markets because of high asking prices by Mexican mines.

The undertone of the market is firm, and higher prices are in prospect. Business has increased somewhat, but the decreased supply is primarily responsible for firmness. However, inquiries, many for large lots, have increased noticeably. Announcement by one large chemical firm that it intends to enlarge its chlorine plant has had an additional firming effect. Prices may well be at the $220 level by the end of March.

Tin prices moved up slightly over 1c during February. Platers moved in for substantial quantities early and continued good buying throughout the period. Business and delayed steamer arrivals pinched nearby supplies here and pushed prices up 1½c. The situation had eased by the end of the month, and the forecast for March was for lesser activity with prices of 100½c to 100¾c.

Average Prices February (E&MJ Quotations)

Cents per lb unless otherwise indicated:

Copper:	
Electro, domestic refinery	32.976
Electrolytic, export refinery	31.994
Electrolytic, c.i.f. Cont'l ports	32.939
Lead:	
Common, New York	12.000
Common, St. Louis	11.800
Silver:	
Silver, New York, per oz	91.375
Silver, London, pence per oz	79.500
Zinc:	
Prime, Western, East St. Louis	13.000
Prime, Western, delivered (g)	13.500
Tin:	
New York Straits	101.000
Gold, per oz, U.S. price	$35.000
Sterling, Exchange	280.329
Quicksilver, per flask	$212.211
Antimony, (E&MJ) (d)	32.590
Antimony, bulk, Laredo	29.000
Antimony, in cases, Laredo	29.500
Antimony for. 99½%	24.875
Palladium, troy oz	$24.000
Platinum, refined, per oz	82.000
Cadmium (a)	140.000
Cadmium (b)	150.000
Al, 99½% dom., ingot	28.100
export, pig	23.250
Magnesium, ingot	35.250
Nickel (f)	74.000
Bismuth	$2.250
Cobalt	$1.750

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quicksilver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.

Custom Smelter Copper

BASED ON flat price and E&MJ average prices sales in U.S. for month of February reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

Delivered consumer's plant	34.500 lb
F. o. b. refinery	34.100 lb

Correction Jan. monthly average

Del.	34.750c
F.o.b.	34.350c

Free Gold Market

INTERNATIONAL gold transactions declined 12½% during February. Bar prices fluctuated narrowly and coins showed fractional losses. Activity in Paris and London was sluggish, while Zurich's trading was brisk. The Soviets sold about 40 tons of gold in London. Dealings in Indian markets were hectic on currency troubles. The U.S. gold stock dipped another $22-million.

Gold Prices Rise

	Coins		Bars (12.5 kg)	
	Jan. 31	Feb. 29	Jan. 31	Feb. 29
New York transit	.....	.....	$35.08⅛	$35.08⅛
Manila	$40.25	$40.50	35.75	35.80
Hong Kong	47.15	48.50	38.90	38.90
Bombay	52.00	51.50	51.50	51.00
Tangier	38.25	38.25	35.05	35.05
Beirut	40.40	40.20	35.18⅛	35.18⅛
Paris	39.75	40.00	35.60	35.65
Buenos Aires	40.35	39.65	35.95	35.85

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

Feb. 1960	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (c)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99% U. S. Dest.	Straits Tin New York
1	33.350	32.225	33.170	12.000	11.800	13.500	13.000	26.000	100.375
2	33.275	31.325	32.270	12.000	11.800	13.500	13.000	26.000	100.375
3	33.125	31.450	32.395	12.000	11.800	13.500	13.000	26.000	100.500
4	33.475	32.025	32.970	12.000	11.800	13.500	13.000	26.000	100.500
5	33.275	32.225	33.170	12.000	11.800	13.500	13.000	26.000	100.625
8	33.175	32.675	33.620	12.000	11.800	13.500	13.000	26.000	100.750
9	33.225	32.350	33.295	12.000	11.800	13.500	13.000	26.000	100.750
10	33.125	33.150	34.095	12.000	11.800	13.500	13.000	26.000	101.000
11	32.825	32.825	33.770	12.000	11.800	13.500	13.000	26.000	101.125
12	Holiday	33.075	34.020			—Holiday—			
15	32.825	33.075	34.020	12.000	11.800	13.500	13.000	26.000	101.375
16	33.250	32.775	33.720	12.000	11.800	13.500	13.000	26.000	101.500
17	32.900	32.350	33.295	12.000	11.800	13.500	13.000	26.000	101.750
18	32.750	32.725	33.670	12.000	11.800	13.500	13.000	26.000	101.875
19	32.700	32.150	33.095	12.000	11.800	13.500	13.000	26.000	101.625
22	Holiday	30.850	31.795			—Holiday—			
23	32.675	30.725	31.670	12.000	11.800	13.500	13.000	26.000	101.500
24	32.650	30.825	31.770	12.000	11.800	13.500	13.000	26.000	101.125
25	32.675	30.900	31.845	12.000	11.800	13.500	13.000	26.000	100.750
26	32.650	31.000	31.945	12.000	11.800	13.500	13.000	26.000	100.750
29	32.625	31.175	32.120	12.000	11.800	13.500	13.000	26.000	100.750
AVERAGES FOR MONTH									
Feb.	32.976	31.994	32.939	12.000	11.800	13.500	13.000	26.000	101.000
AVERAGES FOR WEEK									
Feb.									
3	33.385	32.045	32.990	12.000	11.800	13.500	13.000	26.000	100.400
10	33.255	32.485	33.430	12.000	11.800	13.500	13.000	26.000	100.725
17	32.950	32.820	33.765	12.000	11.800	13.500	13.000	26.000	101.438
24	32.694	31.455	32.400	12.000	11.800	13.500	13.000	26.000	101.531
CALENDAR WEEK AVERAGES									
Feb.									
5	33.300	31.850	32.795	12.000	11.800	13.500	13.000	26.000	100.475
12	33.088	32.815	33.760	12.000	11.800	13.500	13.000	26.000	100.906
19	32.885	32.615	33.560	12.000	11.800	13.500	13.000	26.000	101.625
26	32.663	30.860	31.805	12.000	11.800	13.500	13.000	26.000	101.031

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U. S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West effective Jan. 8, 1960, commanded a premium of 1.25-1.50c per pound over the current market for Prime Western; Special High Grade 1.50-1.75c effective Jan. 8, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U. S. lead is corroding grade).

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver 999 fine as made to Handy & Harman for nearby delivery at New York by regular supplies in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price of which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis 999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Feb. 1960	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
1	91.375	79.500d.	280.2640	250s. 6¼d.
2	91.375	79.500d.	280.3020	250s. 5d.
3	91.375	79.500d.	280.2580	250s. 5¼d.
4	91.375	79.500d.	280.2500	250s. 5¼d.
5	91.375	79.500d.	280.2760	250s. 5½d.
8	91.375	79.500d.	280.2300	250s. 5¼d.
9	91.375	79.500d.	280.2980	250s. 4½d.
10	91.375	79.500d.	280.2620	250s. 4¾d.
11	91.375	79.500d.	280.2600	250s. 4¾d.
12	Holiday	79.500d.	Holiday	250s. 4½d.
15	91.375	79.500d.	280.4200	250s. 3¾d.
16	91.375	79.500d.	280.4000	250s. 2½d.
17	91.375	79.500d.	280.4080	250s. 3¼d.
18	91.375	79.500d.	280.4120	250s. 3¼d.
19	91.375	79.500d.	280.4300	250s. 3d.
22	Holiday	79.500d.	Holiday	250s. 3¼d.
23	91.375	79.500d.	280.3440	250s. 3¾d.
24	91.375	79.500d.	280.3720	250s. 4¼d.
25	91.375	79.500d.	280.3600	250s. 3¾d.
26	91.375	79.500d.	280.3375	250s. 4¼d.
29	91.375	79.500d.	280.3700	250s. 3¾d.
AVERAGES FOR MONTH				
Jan.	91.375	79.500d.	280.329	—
AVERAGES FOR WEEK				
Jan.				
3	91.375	—	280.262	—
10	91.375	—	280.263	—
17	91.375	—	280.372	—
24	91.375	—	280.390	—

Calendar Week Averages: New York Silver: Feb. 5, 91.375; Feb. 12, 91.375; Feb. 19, 91.375; Feb. 26, 91.375.

MARKETS *(Continued)*

London Metal Exchange Quotations

Feb.	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
1	266	266¾	249	249¼	74⅝	74¾	74⅝	74¾	92½	92¾	91½	91¾	793½	794	788½	789
2	255½	256	243½	244	73⅝	73½	73½	73⅝	90¾	90½	89½	89¾	792	793	788½	789
3	258½	259½	244½	245	73⅝	73¾	73⅝	73¾	90	90¼	89½	89¾	792	793	788	788½
4	263¾	264	244½	245	73¾	73⅞	73¾	74	89¾	89⅞	89¾	89⅞	792	793	788½	789
5	271½	272	248½	248¾	72⅝	72½	72⅝	72⅞	89½	89¾	89½	89¾	792	793	789	789½
8	268	270	244½	245	72¾	72½	72⅝	72⅝	89½	89⅝	89¾	89⅞	791½	792	788½	789
9	276⅜	277	249½	249½	71⅝	72	72⅛	72½	89½	89¾	89¾	90	792	793	788½	789½
10	274	275	247½	248	71⅝	72	72¼	72⅝	89¾	89⅞	89⅞	90	792	793	789	790
11	269	270	245¾	246	71⅞	72	72¼	72⅝	89¾	89⅞	89⅞	90	792½	793	790	790½
12	271	272	246¾	247	72⅝	72½	72⅝	73	89½	89½	89½	89¾	792½	793	790½	791
15	272½	273	249½	250	73⅞	74	74½	74½	89¼	89½	89¾	90	793	794	791½	792
16	266	267	247	247½	73½	73¾	73⅝	73¾	88¾	89	89	89¼	793½	794	791½	792
17	266½	267	248¾	248½	73⅞	74	74	74½	88	88⅛	88¼	88½	794	794½	793½	794½
18	269	269½	249¼	249½	74⅝	74¾	74⅝	74¾	86¾	87	87¼	87½	793½	794½	793½	794½
19	266	266½	248	248¼	75½	75½	74¾	75	86¾	87¼	87¼	87½	793½	794	792½	793
22	250½	251½	243¾	244	75⅝	75⅝	74½	75	87½	87½	87½	87¾	792	793	791½	792
23	250	251	243	243½	75½	75⅝	74¾	74⅞	88	88⅛	88	88½	792½	793	791½	792
24	252	253	240¾	241	75	75½	74¼	74½	87½	87¾	87½	87¾	790½	791½	789	789½
25	253½	254	241¾	242	74¾	74½	73¾	74	87⅜	87½	87⅜	87½	789	790	788	788½
26	256	256½	242½	242½	75¼	75½	74¼	74½	87¼	87⅜	87½	87½	789½	790	788½	789
29	257½	258	242½	242¾	75	75⅛	74¾	74½	87	87¼	87¾	87½	788½	789½	787½	788½
Av'g's	£263.869		£243.875		£73.863		£73.744		£88.857		£88.920		£792.269		£790.190	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.9%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty paid.

MISCELLANEOUS METALS

Feb. 29, 1960

Aluminum ingot, 99 plus % lb		28.1c
Antimony, spot, lb, less than carload, in cases		32.59c
In bulk, carload lots, f.o.b. Laredo		29.00c
Imported. 10 ton min. (p), 99½%	25¾c —	25¾c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.40
small lots		$1.50
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 97% grade, lb, contract delivered		$1.29
Cobalt, 97 to 99%, per lb effective Feb. 1, 1957		$1.75
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)29.95c	
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		74c
Other sales, regular sellers		74c
Sales by dealers, etc.		74c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16		35¼
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$82 —	$85
Quicksilver, flask of 76 lb. 25 flasks or more	$213 —	$216
Selenium, 99 plus %, lb—(Feb. 19, 1958)		$7.00
Silicon, minimum 98%, carloads, lb		19c
Semi Conductor grade, lb		$360
Tellurium, lb		$3.00
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective Dec. 6, 1956; including U.S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu: spot		$31.75–32.50
term contracts		$34–34.50
Chrome ore per long ton, f.o.b cars Atlantic ports, dry:		
44% Cr_2O_3 no ratio	(a)	
48% Cr_2O_3 3 to 1 ratio	$33½ —	$37
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.70(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$141.72
Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.		
Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.25
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 60%, c.i.f. U.S. ports, duty extra	$19.50 —	$20.00
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton.		$80

(a) Nominal. (b) c.i.f. U.S. ports.
(e) Effective 1938 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4–5c
Cobalt oxide, 72¾% to 73½%, per lb, effective Dec. 1, 1956	$1.33 —	$1.36
Copper sulphate, 100 lb, effective Nov. 6, '59		$13.00
Germanium dioxide, gm		16½c
Molybdic trioxide, technical, per lb of Mo	$1.46 —	$1.47
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained.	$1.50 —	$1.82
Ferrosilicon, 50% per lb of Si f.o.b. shipping point (3-1957)		14.60c
Ferrotungsten, 72 to 82%, lb of W contained	$3.20 —	$2.15 $3.40
Ferrovanadium, per lb of V delivered		
Silicomanganese, max. 1½% C, lb contracts		11.6c
Spiegeleisen, per lt, 19–21% grade effective Jan. 22		$100.00

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper Stock	$120–$142
Crude No. 2	$750– $1100	Waste	$75– $86
Spinning Fibers	$350– $565	Shorts	$22– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$220–$787
Asbestos, Vermont, f.o.b. Morrisville:			
Spinning fibers	$353– $422	Waste, stucco or plaster	$86
Shingle stock	$181– $218	Refuse or shorts	$41– $75
Paper stock	$120– $142		
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94%, $BaSO_4$, per st	$16 —		$18
Crude oil well grade, min. 4.3 sp gr, st (a)			$18
Imported, c.i.f. Gulf Ports, st	$16 —		$18
Bauxite, st. f.o.b. point of shipment:			
Domestic, crude, 50%, 8% Fe, 13% Si	(c)$12.25 —		$13.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, depending on grade			$7.14
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$20.50 —		$21
Glass feldspar, white, 20 mesh			$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —		$41
60% effective CaF_2	$33 —		$36.50
Acid 97% concentrate, bulk, ton			$45.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —		$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$46

Mica—Domestic, f.o.b. mines. Punch 7c—12c per lb according to size and quality. Sheet clear 1½x2 in, 70c—$1.10; 2x2 in, $1.10 to $1.60; 2x3 in, $1.60—$2.10; 3x3 in, $1.80—$2.30; 3x4 in, $2.00—$2.60; 3x5 in, $2.60—$3.00; 4x6 in, $2.75—$4.00; 6x8 in, $4.00—$8.00. Wet ground, very fine, $140—$155 per ton, Bulk sales, dry ground; $30—$55 per ton. Scrap $20—$30.

Ocher Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, long ton, U. S. producers' posted quotations*		
f.o.b. mines, bright		$23.50
dark		$22.50
f.o.b. vessel, bright		$25.00
U. S. ports, dark		$24.00

*Prices will vary from these depending on the competitive situation; currently U.S. sulphur sells at close to Mexican export prices

Mexican, for use in Mexico, per metric ton, f.o.b. mines, depending on location	$21.00 —	$23.00
For export f.o.b. vessel, lt, depending on grade	$20.50 —	$22.00
Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50, (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

HERE'S UNRETOUCHED PROOF of how the new B.F.Goodrich Cut Protected compound wears longer. Both tires were in service at the same time on identical jobs under identical conditions. Yet the Cut Protected compound tire at the top has given *approximately 900 hours more service* than the tire below. Note how little the CP tread is worn.

TRUCKS HAUL 44 TON gross loads over razor-sharp rocks at this Pennsylvania strip mine. Here's a job for the B.F.Goodrich Cut Protected compound tire. If the problem were dangerous heat build-up, you'd choose the new Heat Resistant compound.

B.F.Goodrich develops 2 new long-wear tire compounds

B.F.Goodrich Cut Protected and Heat Resistant compounds boost tire life, cut costs on mine jobs

TESTS show that B.F.Goodrich Rock Service tires made with new Cut Protected or Heat Resistant compounds outperform any other tires on the market.

Cut Protected compound gives longer service on jobs where:

- Rock cutting, chipping and abrasive wear are severe.
- Round-trip hauls are short.
- Trucks travel at low speeds.

Heat Resistant compound defies dangerous heat build-up on jobs where:

- Haul roads are well maintained.
- Trucks travel at high speeds.
- Cutting and chipping are at a minimum.

Intensive B.F.Goodrich research and testing went into the development of these compounds. Only B.F.Goodrich makes Cut Protected, Heat Resistant, and Regular compound tires that are actually tailor-made for your type of work. Your B.F.Goodrich Smileage dealer will recommend the best one for you. He's listed under Tires in the Yellow Pages of your phone book. *The B.F.Goodrich Company, Akron 18, Ohio.*

Specify **B.F.Goodrich Tubeless or tube-type tires when ordering new equipment**

OFF-THE-ROAD TIRES BY **B.F.Goodrich**

Question 1:

What's <u>different</u> about Haulpak®?

ANSWER: The LW Haulpak is like other off-road trucks *only* because it has wheels and an engine! Otherwise, its design is completely different... for your benefit. For instance:

RIDES ON AIR — Other trucks ride on steel springs that need much attention. Haulpak eliminates this major cause of downtime with the exclusive LW HYDRAIR* suspension system. With it, Haulpak *rides on air*... the load rides smooth and level on rough roads. You can safely use faster hauling speeds, move more tons per hour. Hydrair also makes possible many other advantages:

SHORTER TURN RADIUS — Because Hydrair suspension eliminates need for conventional springs and

Notice the deep "V" body which permits Haulpak to carry about 25% of its load below what would be the floor line of a conventional hauler. This gives greater stability, permits faster travel on turns and steep grades. ▶

Here's HYDRAIR

This sturdy, simple air-hydraulic suspension replaces the usual leaf springs found in conventional off-road equipment, relieving Haulpak owners from expensive spring repair and maintenance. Hydrair cushions against loading and travel shocks, compensates automatically for off-center loading, and keeps the load riding level over bumps and holes, for faster, more profitable hauling cycles.

Question 2:

How does Haulpak <u>save you</u> money?

ANSWER: From the answers above you can easily see how this all-new hauler *saves* on hauling costs, gives you:

- **greater maneuverability**
- **lower operating cost**
- **lower maintenance**
- **faster hauling**
- **more pay-tons per hour**
- **...and bigger profits**

front axles, Haulpak's front wheels can be turned at sharper angles . . . permits U-turns in 2/3rds the space required by competitive trucks. And without need for springs and axles, Haulpak can be built with a shorter wheelbase for more efficient transfer of power-to-wheels. There is, however, no loss in load capacity, because you get the LW exclusive . . .

DEEP "V" BODY — This permits carrying about 6 tons of material *below* the normal floor-line of conventional trucks. It also gives you a lower center of gravity, better stability on turns and steep grades.

HAULS THROUGH DEEP MUD — Haulpak is equipped with the famous LW power-transfer differential, used for many years in thousands of heavy-duty Tournapull® earthmovers all over the world. When one drive wheel begins to slip, power is transferred automatically to the wheel on firmest footing. Soft going does not stop Haulpak!

MANY OTHER MONEY-SAVERS! You save on fuel, because Haulpak is built of the newest lightweight high-tensile strength steels . . . to reduce deadweight and increase pay-load. Also, Haulpak gives you power-shift Torqmatic transmission, full power-steering, multiple-disc brakes with 5,148 sq in. total braking surface, double-acting hydraulic rams that lift body to 70° tilt in 16 seconds for fast dump. And lubrication check is reduced to only 3 easily-reached fittings needing attention only at 500-hr intervals. Haulpak is not just a "beefed-up" highway truck . . . it is a totally new concept developed to cut off-road hauling costs.

Next time you need an off-road hauler, investigate Haulpak. Now available in 3 sizes: 22, 27, and 32 tons capacity. Request literature, and ask to see our new color movie, "*Revolution on Wheels*".

*Trademark HP-2261-G-2

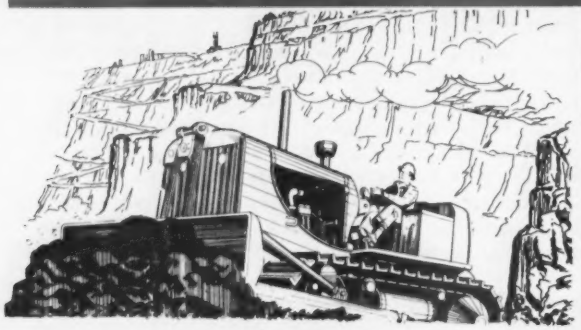
LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

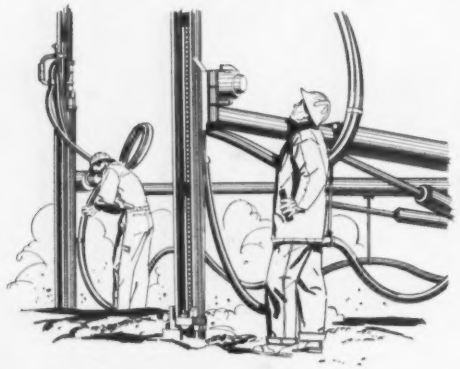
LUBE LOGIC

these TIPS can trim your maintenance costs



DON'T LET ENGINES FOUL UP!

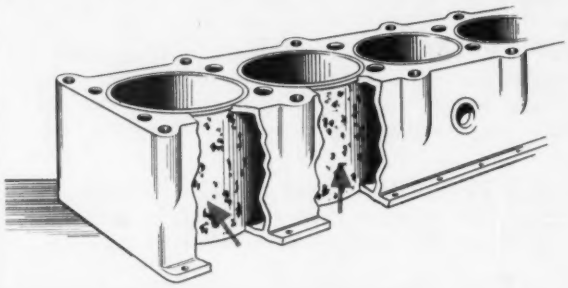
If the fuel injector on a diesel drifts and dribbles, some of the fuel will end up in the crank case. Also there will be plenty of smoke—and probable engine trouble. The injector should be fixed immediately—but if it can't be, start shortening drain periods to remove the contaminated oil-fuel mixture. Also, use an oil with full detergent and dispersion properties to keep other undesirable products out of the engine.



NEW PRODUCT FOR ROCK DRILL COUPLINGS

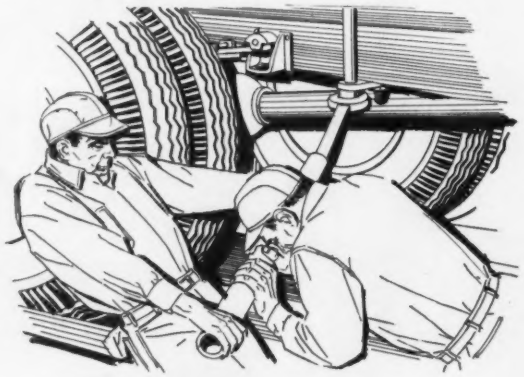
Actually it's an old friend, Marfak Heavy Duty #2, in a new application. According to the raves from customers who've tried it, the lubricant works better on rock drill couplings than anything they've ever used.

Your Texaco Lubrication Engineer is your best source for money-saving maintenance ideas—and for a Simplified Lubrication Plan tailored to your operation. Don't forget that "Lubrication is a major factor in cost control." Texaco Inc., 135 East 42nd Street, New York 17, New York.



NEW WAY TO STOP CYLINDER CAVITATION

High pressure cooling systems in use in most super-charged diesels are subject to coolant aeration. This aeration can cause cavitation, leading to cylinder liner corrosion-erosion, unless a rust preventative is added to the water. A good anti-freeze will do the job in winter—but in summer 1% to 2% Texaco Soluble Oil C will do a fine job. (Remember to flush out before you add anti-freeze again.)



HOW TO AVOID THAT FROZEN BOLT

Ever spend hours fighting a U-bolt that's decided to corrode itself tight? It's an unforgettable experience—and one you can avoid by just digging up the price of a pack of gum. All you need is a dash of Texaco Threadtex to keep that bolt rust-free. Ask your Texaco man to tell you about it.

TUNE IN: TEXACO HUNTLEY-BRINKLEY REPORT, MON. THRU FRI.—NBC-TV

TEXACO

Throughout the United States

Canada • Latin America • West Africa

Cut pit costs with Tournatractor®...

It travels faster ...works faster

For your *own* satisfaction, determine the money-saving advantages you get with a big LeTourneau-Westinghouse Tournatractor. Do some stop-watch-timing on this tractor and compare its performance with any tractors you may *now* own.

You'll find, if assigned to clean-up duty around a number of scattered shovels for instance, that a track-type tractor spends much of its time just traveling between jobs. And travel time accomplishes *nothing*. It only adds to your operating costs. Or, if you assign one tractor to *each* shovel, you'll notice that here, too, there's liable to be a lot of waste time, because there isn't enough work to *keep one tractor busy*.

Fast work and travel speeds offer a big advantage

With Tournatractor, you cut tractor "travel overhead" by more than half. That's because, on job-to-job travel, Tournatractor moves more than twice as fast as the fastest crawler tractor. It runs between assignments... at speeds to 17 mph! You'll find a single rubber-tired LW tractor handles more work over a wider area than *2 or more crawler tractors!*

And because Tournatractor is fast, don't get the idea it's just a "hit-and-run" flyweight. Not on your life! It's got the sock and ruggedness of a true "heavy". With 218 hp and up to 15 tons of work-weight, it can match production with any tractor its size. Use an LW tractor for shovel clean-up... for spotting rail cars... for fast push-loading or towing service... for heavy construction or dozing to improve haul roads and drainage. You'll also find Tournatractor a "natural" for compacting stockpiles, because when those big tires are hydroflated, Tournatractor provides compaction equivalent to an extra 20-ton roller.

Let us show you how Tournatractor can fit into *your* operations. See how this fast, mobile machine can help you cut costs in a hurry!

CT-2202-MQJ-1

This Tournatractor is one of 3 owned by Bagdad Copper Corp., Bagdad, Arizona. At its open-pit mine the firm works LW tractors 16 hours a day to clean-up around shovels... to maintain waste dumps and haul roads... to tow stalled trucks and other equipment. Says Mine Superintendent Edward L. Jones, "Our Tournatractors complete a variety of scattered jobs over a wide area fast!" Operator Edgar D. Owings adds, "I sure like the torque converter on this tractor and the big low-pressure tires have more traction, make it smoother riding, too."

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

FOR REALLY EFFECTIVE RESULTS ON YOUR NEXT SHOT...

WHICH EXPLOSIVE?

This is a photographic enlargement of Atlas Pellets.

New explosives, blasting agents, and techniques are being developed at an ever increasing rate. Operators are using these developments to find new answers to the old problems of getting more payload work from shovels, trucks, crushers, conveyors . . . all their equipment all along the line. And they are finding that the lowest true blasting costs depend upon determining *which explosive* and which blasting methods combine to give the best breakage, displacement, and control at the lowest overall cost.

For example, are you familiar with one of the newest developments . . . ATLAS PELLETS? They are a new form of ammonium nitrate designed especially for blasting. They are porous, compact particles which have oil absorption characteristics equal to that of prills. Yet they have higher density for more efficient blasting. And they are exclusive with Atlas. But just because they are new, they are not necessarily the best explosive for your operation. Ask your Atlas representative about Pellets, and about the complete Atlas Line. It's his job to help you decide which explosives make the right combination to give you really effective results on your next shot.

There is only one way to look at explosives costs, and that is: which explosive will give you the most payload service from all your equipment? Our blasting cost chart, slide rules and technical literature are designed to help you do exactly that. Ask your Atlas Representative about them . . . or, write directly to:

ATLAS POWDER COMPANY
Explosives Division, Wilmington 99, Del.

ATLAS EXPLOSIVES

When you use the right combination, all your equipment moves in sooner... works faster... produces more.

ATLAS PELLETS, a new form of ammonium nitrate, have both the density and sensitivity required for efficient ammonium nitrate blasting.

GIANT GELATINS are for high velocity shattering action. They are advantageous for extremes of wet work and for hard, tight shooting.

GIANT "75" PRIMERS have the wallop required for complete, efficient detonation of both field mixed and plant mixed blasting agents.

ROCKMASTER® electric blasting caps achieve the staggered action which has been so important in producing better breakage and control.

Why walking dragline owners TAKE THE JOBS THEY WANT!

Unfortunately, many people don't know a whole lot about walking draglines. We say unfortunately because *where walking draglines apply,* nothing — and that means no machine built in America today outside the wheel excavator — can move earth at such low cost. How low? Four cents . . . six cents . . . or eight cents a yard, and that is cheap! That's why walking dragline owners *take* the jobs they want.

Here's why dirt-moving costs are lower: The walker sits on a "tub" that gives it great flotation. It walks on a simple, giant system of beams which lift it up . . . move it ahead . . . set it down. Maintenance is low compared to *any* crawler excavator. The life span of a walker is literally unknown. The rigs don't wear out as fast, therefore have greater resale value.

The extra stability of a walker lets you use longer booms, work a greater area from each set position, reducing the number of moves. For a like investment, you can get a bigger capacity walker than crawler — you move more dirt per hour per dollar invested.

How mobile is a walker? Walkers travel at about half the speed of comparable size crawlers, but maneuver much faster because in reality they don't have any maneuvering problems that compare. You don't turn a "tub" around to maneuver! You simply *swing* around, the legs go with you, and move out wherever you choose. The time saved makes up for the slower travel speeds.

How do you make the choice? In simplest terms, the walker is best where flotation is a major problem, where deep digging and long reach are required, or where you have huge quantities of material to be moved at the lowest possible cost per yard.

Walkers don't need or use mats in soft ground. You don't have profits tied up in used mats when the job is done. Walkers have stability that allows them to work in precarious locations out of the question for crawlers.

Don't misunderstand. The walking dragline won't cure all excavating cost woes. There are jobs where crawler machines are better by far. And, there are jobs where you will throw away profits by using anything *but* a walker.

If there's a question in your mind, and you are interested in making a good profit on a job, you should know the facts before you make an investment. We'll welcome the opportunity to talk more about *how* walkers work . . . *where* they work best.

We may tell you *not* to buy a walker. Remember, Bucyrus-Erie builds crawlers, too.

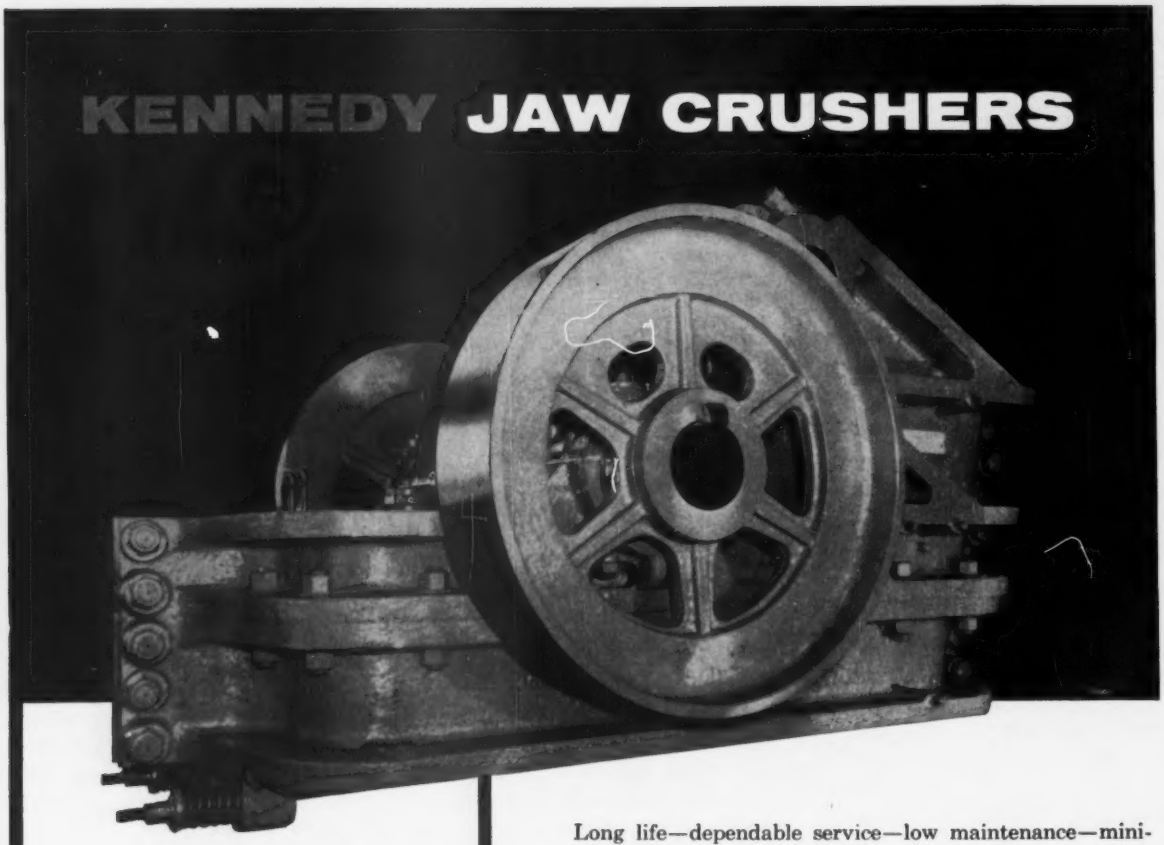
(For answers to questions, write Bucyrus-Erie Company, Dept. 2L60, South Milwaukee, Wisconsin.)

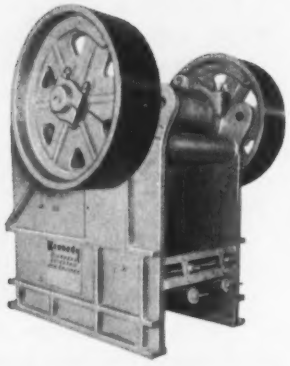
CLEANING AND WIDENING of drainage canal in bayou country of southeast Arkansas is sticky job for Kenyon Construction Corp. Kenyon is handling it with his Bucyrus-Erie 480-W walking dragline equipped with a 15-yd. bucket, 160-ft. boom. Machine is handling between 6,000 and 12,000 yds. per station. Contract was awarded on a bid of 7.6¢ per yard.

BUCYRUS ERIE®

...the most respected name in the field

KENNEDY JAW CRUSHERS





The KENNEDY Overhead Eccentric Jaw Crusher features a massive, one-piece, arc welded steel plate frame, and is available in standard sizes from 10″ x 36″ to 36″ x 42″.

Long life—dependable service—low maintenance—minimum power—high production—make KENNEDY Jaw Crushers the first choice of all who buy because of proven performance and low year-to-year cost.

Exclusive features of the KENNEDY Jaw Crusher

- Cast Meehanite or steel frame.
- Counterbalanced flywheel lifts pitman at bottom of stroke. Makes starting easier.
- Split frame design distributes stresses evenly. There can be no failures at the corners.
- No loss of power due to "weaving" and misalignment common to ordinary 4-piece crusher frames.
- Rocking toggles require no lubrication.
- Each jaw bears exactly half the load because both are mounted at the same angle. No power is wasted in lifting the charge.
- Jaw plates are interchangeable and reversible. Shaft is integral with swing jaw.
- Available in standard sizes from 7″ x 10″ to 66″ x 84″.

Send for complete information on KENNEDY Crushers.

KENNEDY VAN SAUN

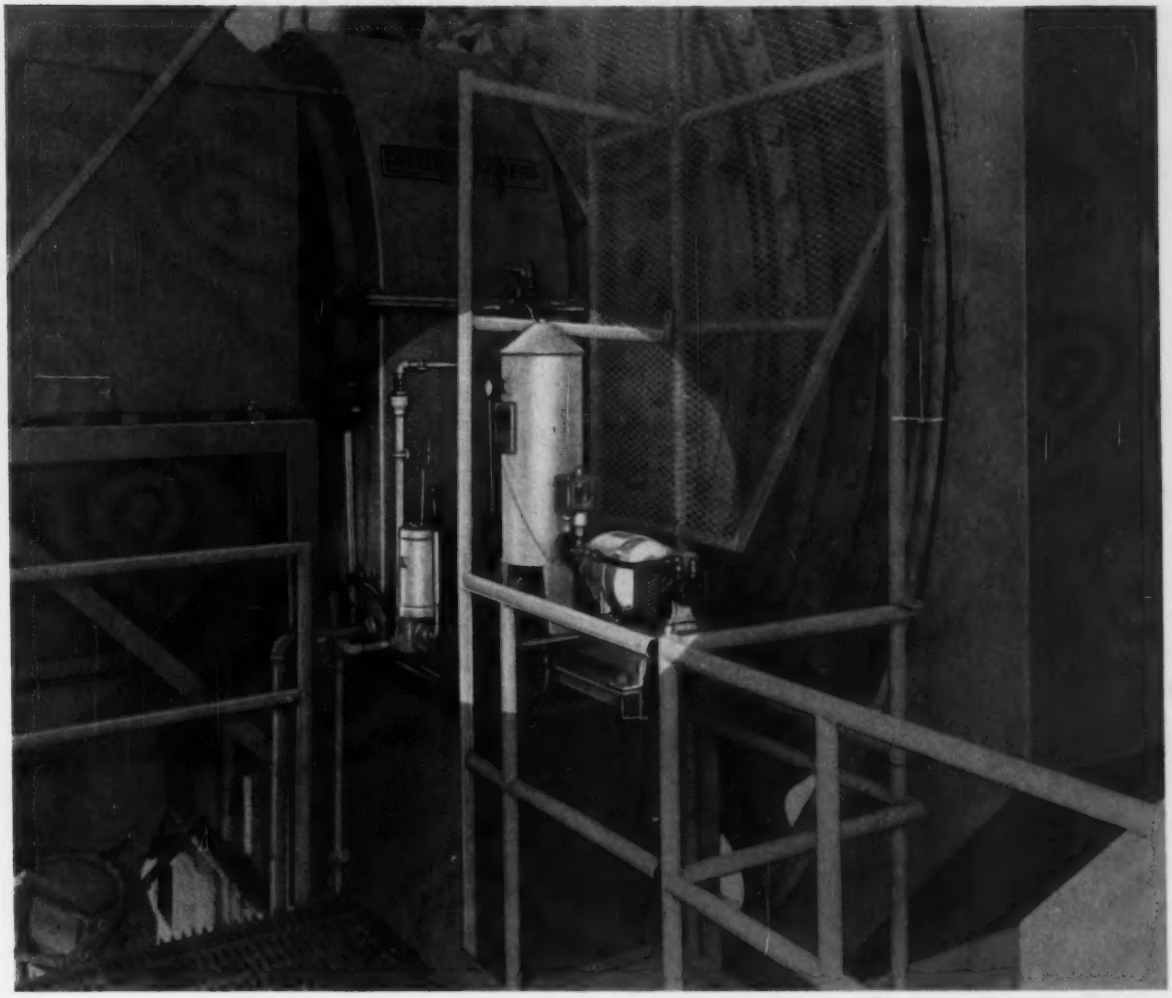
MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.

Primary & Secondary Gyratory Crushers • Jaw Crushers • Roll Crushers • Impact Breakers • Hammer Mills • Rod & Ball Mills • Kilns • Dryers • Screens • Mechanical & Pneumatic Conveyors • Complete Crushing, Lime, Cement & Carbon Paste Plants. KENNEDY Research & Testing Service.

ALLIS-CHALMERS

A-1269



Floating start, ride and stop for big mills

New Lubritrol system provides constant lubrication for trunnion bearings

The new, bigger A-C grinding mills actually *float on oil.* Process industries are grinding out bigger profits because of *Lubritrol* constant lubrication system. No bearing-wearing starts. No dry sliding after shutdown. Less wasted horsepower. All functions of the *Lubritrol* system are automatic... controlled by foolproof pressure gauges and switches. The system is filtered to remove contaminants.

When you modernize your operation, check the benefits of an Allis-Chalmers grinding mill — the only mill that gives you the positive protection, the operating and maintenance economy of *Lubritrol* constant lubrication. *See your A-C representative, or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin. In Canada, write Canadian Allis-Chalmers Ltd., Box 37, Montreal, Quebec.*

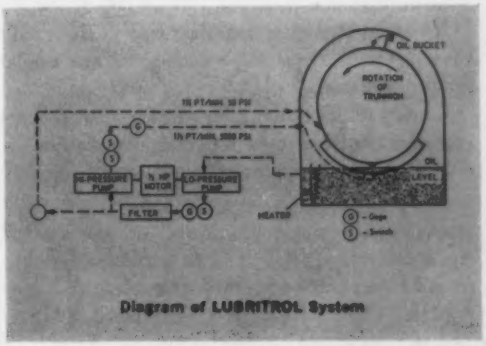
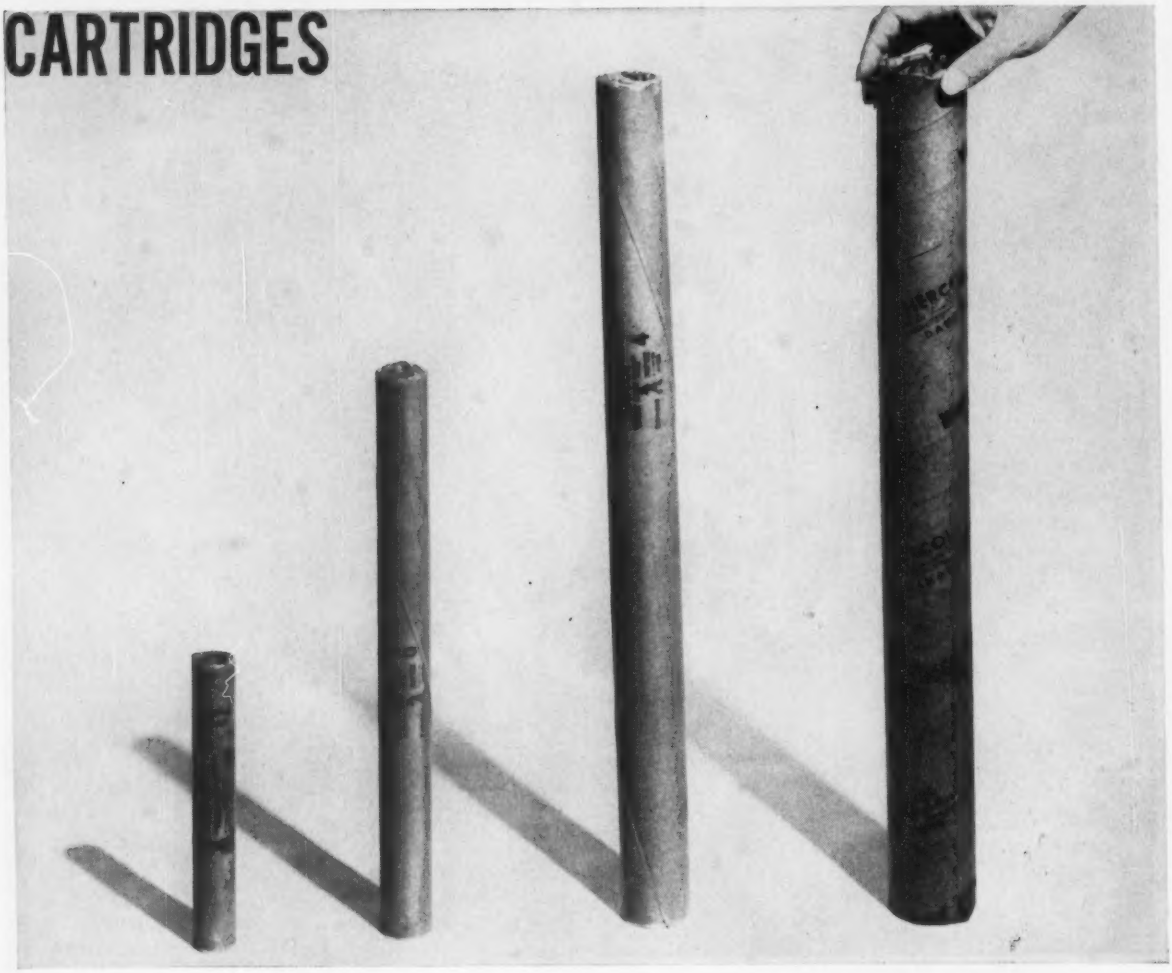


Diagram of LUBRITROL System

Lubritrol is an Allis-Chalmers trademark.

HERCOL®—A LOW-COST EXPLOSIVE—NOW AVAILABLE IN SMALL-DIAMETER CARTRIDGES



The Hercol series of low-cost, cap-sensitive, high-ammonia-content explosives are now available in cartridges of small diameters and standard lengths, as well as in the larger diameters and special packings.

The ability of Hercol to produce excellent fragmentation, its water resistance, Class 1 fumes, and high cartridge count—plus its low cost—have already been proved to the economy-minded quarry and open-pit operator.

Now that Hercol is manufactured in the smaller diameters, with Class 1 fumes, these same economies are available to the underground operator.

Contact the Hercules sales office nearest you or ask your Hercules representative for more detailed information on how Hercol can reduce blasting costs for you, too.

Properties of Hercol

	Hercol	Hercol 2	Hercol 4	Hercol 6
Fumes	Good	Good	Good	Good
Cartridge count—1¼ by 8-in. cartridges per 50 lb.	130	120	140	165
Cartridge diameter, in.	4 to 8½	1 to 3½	1 to 3½	1 to 3½
Weight strength, %	70	68	68	68
Cartridge strength, %	48	50	34	19
Water resistance	Fair	Good	Fair	Fair

A special grade of Hercol is formulated for seismic "pattern shooting" when the drill-holes are relatively dry.

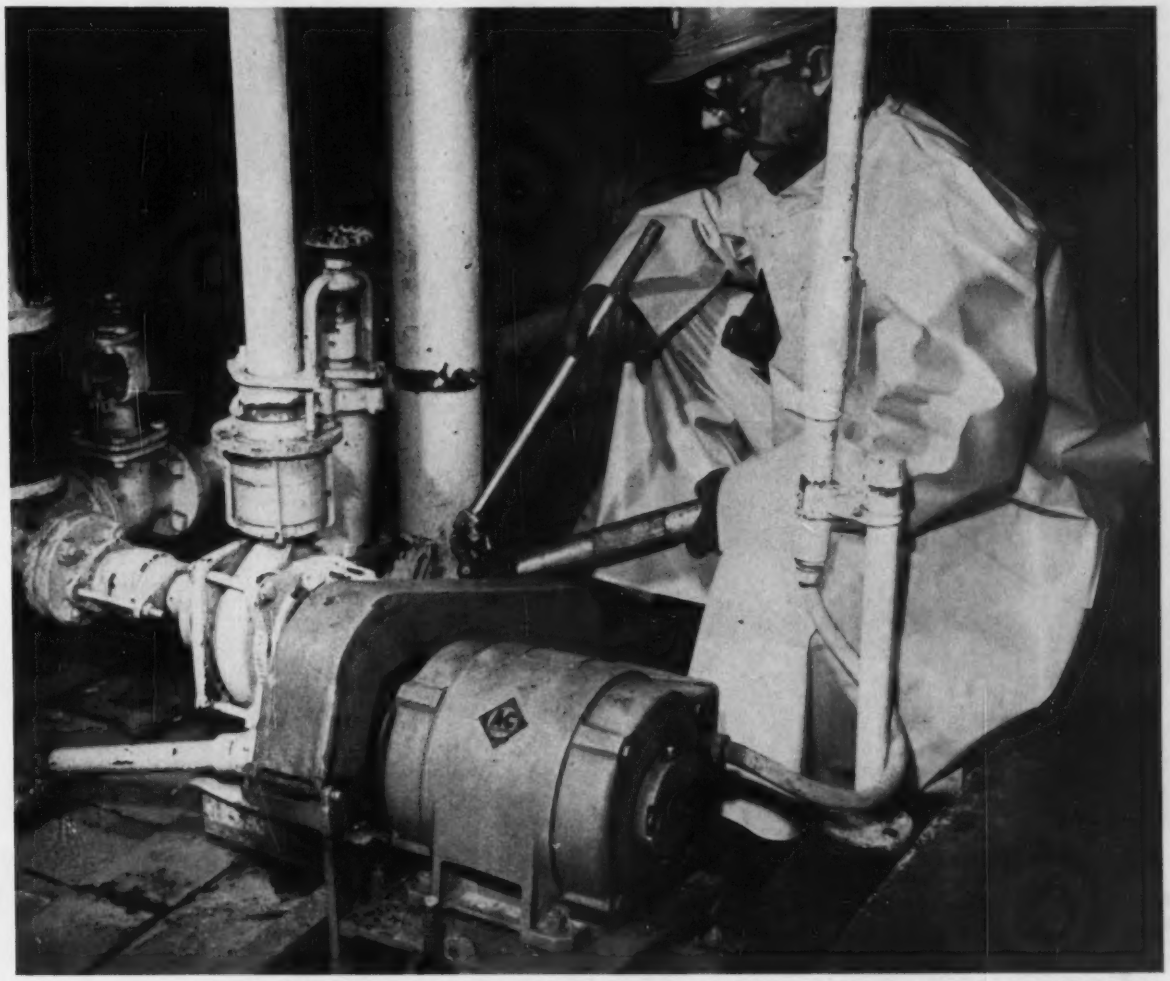
Explosives Department
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington, Delaware

XR60-1

BIRMINGHAM • CHICAGO • DULUTH • HAZLETON • JOPLIN • LOS ANGELES • NEW YORK • PITTSBURGH • SALT LAKE CITY • SAN FRANCISCO

ALLIS-CHALMERS

A-1235



ACID AREA APPLICATION. Safety equipment and clothing are a "must" for personnel in the acid atmosphere of Dow's chlorine plant at Freeport, Texas. This **Super-Seal** motor came prepared, too — with **Poxeal** insulation guarding the stator.

Nothing...but nothing...stops Super-Seal motors

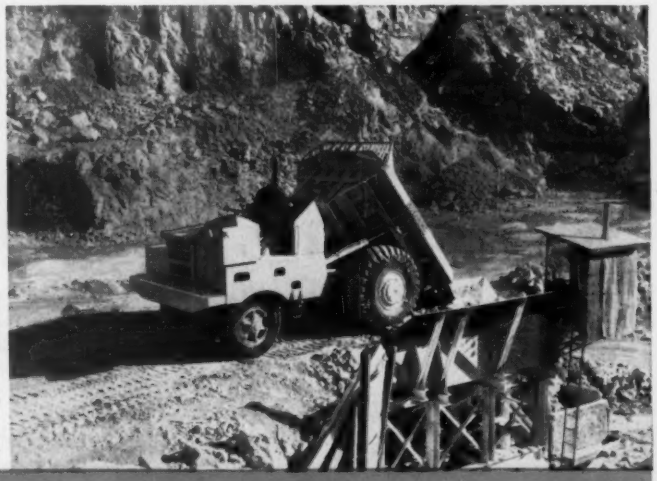
In a tough acid pump installation, Dow Chemical's Texas Division experienced no end of motor troubles. It seemed nothing could stand up in that humid, corrosive atmosphere. Reports Dow: "Even with totally enclosed motors, winding failures were frequent." And, they might have added, expensive.

Then came *Super-Seal* motors— with amazing *Poxeal* insulation. A durable case of epoxy-resin encloses the winding end turns and slot portions of the stator . . . the most complete protection ever developed. Result? The *Super-Seal* motor, *after two years* of continuous operation in the acid area, is as good as ever. So good, in fact, that Dow has ordered 150 *Super-Seal* motors for a new chemical plant at Freeport, Texas.

Isn't it time to revaluate *your* motor standards? There's a good chance that *Super-Seal* motors can solve your motor problems, too. Contact your A-C representative or distributor, or write **Allis-Chalmers,** General Products Division, Milwaukee 1, Wisconsin.

Super-Seal and *Poxeal* are Allis-Chalmers trademarks.

Get no-turn shuttle-hauling with



2-WAY CONTROLS — Operator always faces direction of travel . . . swings around *without leaving seat.* Pivoting seat with 2-way controls lets him operate with equal ease, comfort, safety in either direction. These unique features plus Dumptor's equal speeds in both directions eliminate need for turning at the loader . . . on the haul road . . . or at the dumping area.

2 WAYS TO DUMP — During *instantaneous gravity dump* . . . operator releases fast by-pass of fluid in hydraulic cylinders . . . gravity takes over . . . dumps load instantly. Or, operator can apply *controlled gravity dump.* Hydraulic system acts as a retarder. Gravity actually tilts the body . . . hydraulic pressure controls the rate of discharge.

BIG 15-TON Koehring® Dumptor®...

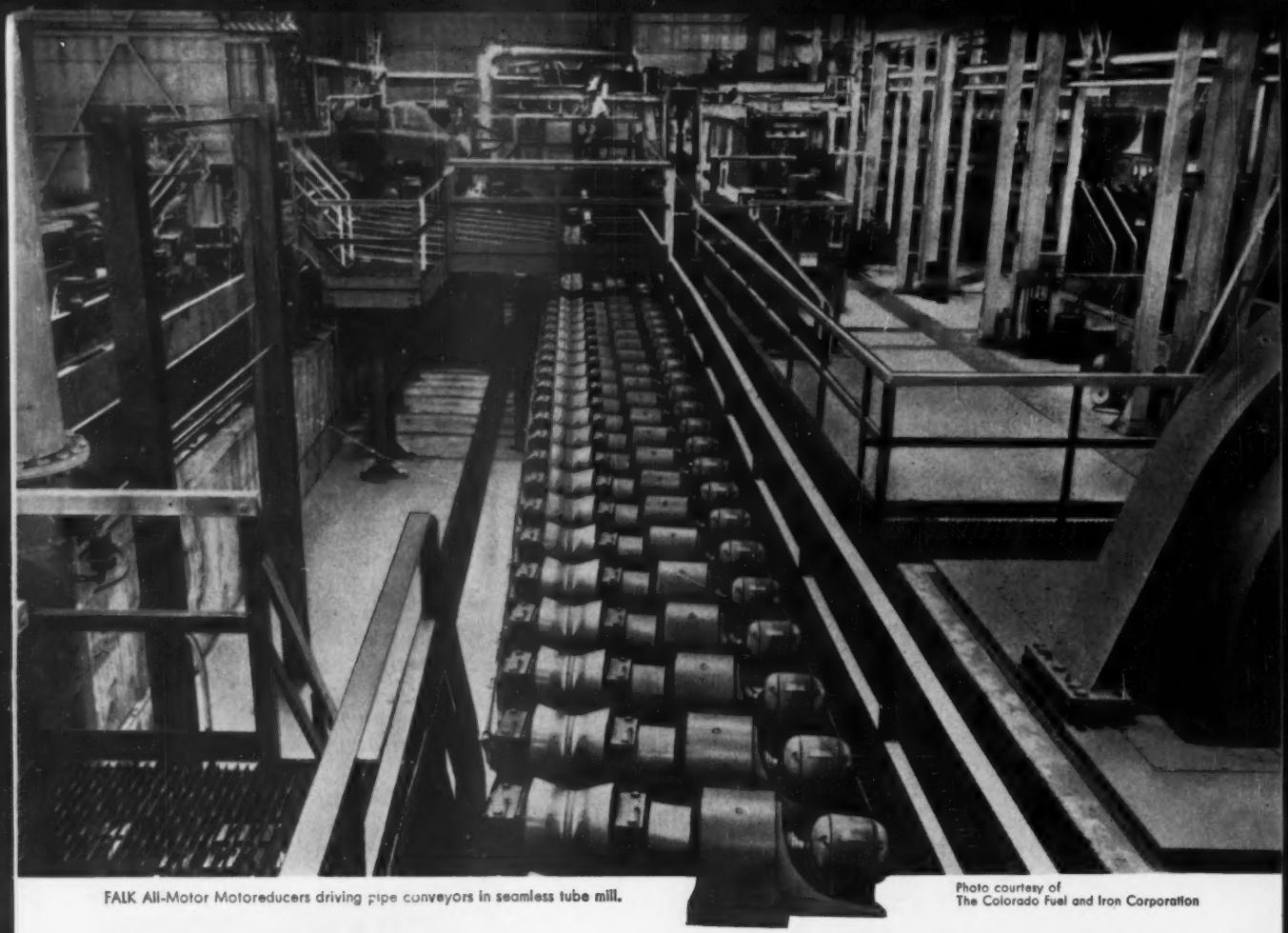
dual controls . . . pivoting seat . . . 24 mph speeds in both directions

- **Two steering wheels, throttles, brake pedals . . . one each located at *both* operating positions of *pivoting* seat.**
- **Directional travel and speed-range lever, and dump controls, centrally-located for 2-way operation.**
- **Speed range selections up to 24 m.p.h. in either direction controlled by easy-acting hydraulic clutches.**
- **Constant-mesh transmission with smooth torque converter drive . . . hydraulic power steering.**
- **2 ways to dump — *instantaneous* gravity dump . . . or *controlled* gravity dump with hydraulic cylinders.**
- **30,000-lb. payload capacity . . . 28.5% gradability . . . big, safe, 4-wheel airbrakes, plus parking brake.**

See for yourself how this big 15-ton Dumptor, with its unique shuttle haul advantage, can profitably boost output in your open pit, or underground mine. Call your Koehring distributor for a demonstration . . . do it today!

2 SIZES — In addition to the new 15-ton, Koehring builds a smaller, companion model 8-ton Dumptor (above). It has a ton of strength for every ton of payload capacity . . . 6 H.P. for every ton of loaded weight . . . 3-speed travel in both directions . . . 1-second dump . . . many other cost-cutting advantages for heavy-duty off-road hauling. Put Koehring Dumptor on your work.

LOAD WITH KOEHRING — Get lowest costs on hauling, stripping, loading . . . team Dumptors with Koehring heavy-duty shovels. ½-yard 205 is shown above. Other sizes up to 3-yards . . . including high-lift stripping shovels. Fully convertible to clamshell, dragline, lift cranes. Also check sensational new Koehring Skooper — free-swinging, full-revolving, 2-yard loader.



FALK All-Motor Motoreducers driving pipe conveyors in seamless tube mill.

Photo courtesy of
The Colorado Fuel and Iron Corporation

You get these "extras" when you buy FALK *all-steel* Motoreducers

1. **Freedom from damaged housings.** The exclusive FALK *all-steel* construction gives full protection from cracked housings or torn-off feet...plus twice the ability of cast iron to maintain vital alignment.
2. **Inherently stronger gear teeth.** By AGMA standards, Falk extra-depth, high pressure angle helical gears are inherently stronger than ordinary helical teeth, thus assuring reliable operation and longer gear life.
3. **Highest known gear efficiency**—98½% per gear mesh under full load! This means maximum productive work for your power dollar.
4. **Longer service life**...advanced FALK design makes it possible to machine both bores for each shaft assembly at one time, thus eliminating possible accumulation of tolerances that occurs when individually machined parts are assembled. The result—better alignment of revolving elements that permits units to transmit rated capacity longer.
5. **Standard units to fit your needs.** Integral and All-Motor® Motoreducers are available in horizontal, vertical and right angle types...a type for every use.

Units are available up to 75 hp; output speeds from 780 rpm down to 1.2 rpm. Prompt delivery from factory, warehouse or distributor stocks. Ask your FALK Representative or Authorized FALK Distributor for *Bulletin 3100.*

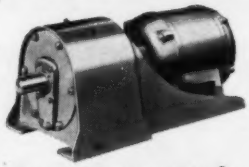
THE FALK CORPORATION, MILWAUKEE 1, WIS.

MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS

Representatives and Distributors in most principal cities

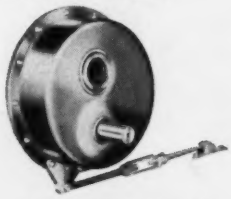
FALK

...a good name in industry



THE FALK ALL-MOTOR® MOTOREDUCER
the original All-Motor unit

(Shown) Horizontal concentric model. Also available in right angle and vertical types.



THE ALL-STEEL FALK® SHAFT MOUNTED DRIVE

Proved best for the countless industrial applications where a reducing unit mounting directly on shaft of the driven machine is indicated.

Units from 1/2 to 50 hp. Ratios —4:1, 14:1 or 24:1. Torque capacity up to 41,000 lb-in (in standard units). Prompt shipment from stock. For details, ask for ***Bulletin 7100.***

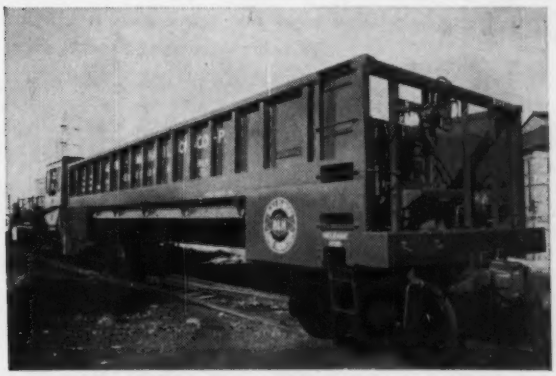
NEW PRODUCTS DIGEST

Powerful Silicon Rectifier Offers Greater Aluminum/Kwh Output (1)

A THREE-YEAR joint development program by Westinghouse Electric Corp. and Aluminum Co. of America has lead to a compact ac-to-dc silicon converter that can produce up to 4% more primary aluminum per kilowatt-hour than comparative size rotary converters. Rated 10,000 amp at 600 v, the converter has greater current-carrying capability and higher efficiency than any previous large silicon rectifying equipment.

The converter delivers 6,000 kilowatts from only 312 silicon rectifier cells—considerably more power per cell than ever before obtained in large silicon rectifiers. By using high-efficiency rectifying devices (thus eliminating the need for elaborate apparatus to discharge heat generated by the ac-to-dc conversion) with a corresponding reduction in the number of devices needed to build the new converter, Westinghouse was able to contain the equipment in an aluminum cubicle 9 ft wide by 5 ft deep by 10 ft high. The unit requires about one-third the floor space of other types of rectifying equipment having a similar rating (see photo) and it is comparable in physical size to previous silicon rectifying equipment having only half the output.

Alcoa vice president B. J. Fletcher cited the new development as promising major advantages to the U.S. electrochemical industry. "The result of this joint Alcoa-Westinghouse project," he said, "offers greater output per kilowatt for aluminum smelting and various other electrochemical operations throughout industry. . . ."



Eddystone Designs Efficient Gondola (2)

A BRIGHT RED GONDOLA CAR of an entirely new design moved out of a siding at Eddystone, Pa., not long ago on the first leg of a 6000-mile barnstorming trip to major ore processing centers. Across the country, ore processors and railroad officials will watch the car's performance as it goes through trial runs during the next few weeks. They are hoping that the car lives up to its designers' expectations.

If it does, iron ore, copper concentrate producers and other large-scale processors of ore and chemicals will be able to use the new car to save hundreds of hours a month in unloading time and reduce to nearly zero the loss of valuable minerals.

The sides of the new Eddystone (Baldwin-Lima-Hamilton) dump car slope slightly outward at the bottom, eliminating the tendency of materials to adhere to the sides of the car when it is emptied and a special paint further reduces the chances of materials sticking to the sides of the car. Two air-operated doors, 9 ft, 9 in. wide by 21 ft long, open at the bottom of the car with a quick-dumping action. Welded to the ends of each door is a steel blade device which extends up into the body of the car and acts as a knife or scraper along the end plate. Special rubber seals, fastened to the inside of the door plates, run along three sides of each door to prevent liquids from leaking out of the car.

Opening and closing of the doors is controlled by a single lever which actuates four pneumatic cylinders. An "over center" lock position on each door mechanism insures that the doors will not open accidentally. A spring-loaded pin in the cylinder head drops into a notch in the actuating piston rod. Before air can enter the cylinder to open the door the air must pass through a chamber which lifts the pin out of the notch.

The payload capacity of the Eddystone gondola is 88 tons with a usable cubic capacity of 950 cu ft. Empty, the car weighs approximately 63,000 lb.

Baldwin-Lima-Hamilton engineers visited the U.S. Southwest to study the conditions existing in the shipment of copper concentrates at the request of Southern Pacific Railroad engineers. Here are some of the things they found out:

Three general types of cars are in use for shipping concentrate by rail: drop bottom gondolas, center opening hopper cars and side door opening cars.

Wet soupy concentrate leaks out of the bottoms of cars causing losses of up to 1,000 lb of material per car on each trip.

Concentrate remains in cars from one to four days in traveling to the smelter. During this time, sun may dry it out to a hard cake or rains may dilute it to the consistency of soup.

Hard caked and compacted concentrate requires as many as four to six men working with air lances to start the material flowing into bins at the smelter. Further labor is required to keep the material moving and to clean off all sloping surfaces.

Sometimes, the concentrate arrives at the refinery in such a soupy condition that the cars are left standing for nearly a week to dry the material before unloading. In these instances, the dried material has to be loosened with jack hammers and then transferred with clam shells and hand shovels to other cars for dumping into bins.

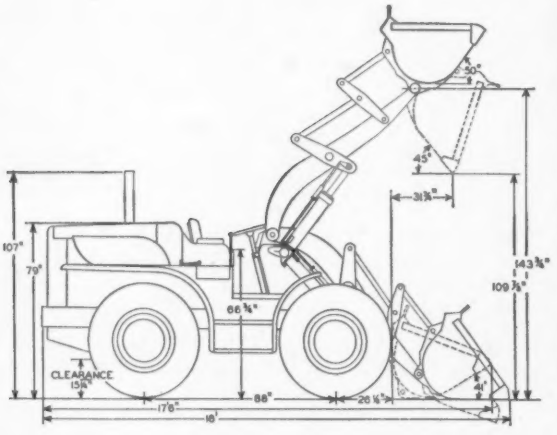
At Hayden, Arizona, American Smelting & Refining tries to unload about 30 cars per day. At times, confronted with several cars of material too sticky to process, Hayden must wait until the material is dry, then work nights, Saturdays and Sundays to get back on schedule.

At Hayden, concentrate received in gondola-type cars. The material is transferred from the gondolas to smaller bottom dump cars by clam shell, then these smaller cars are emptied into the bins with the aid of men with air lances.

After the gondolas are emptied as completely as possible in this way, hand shovels are used to remove most of the remaining concentrate. Finally, the cars are moved onto a paved apron where material on the draft beams, brake rigging, etc., is removed and shoveled by hand into a car for transfer to the bins.

Drop bottom cars now in use are required to be spotted for one entire day on the railroad's rip track after each unloading in order to prepare the car for its next loading with concentrates by sealing the doors with cardboard.

B-L-H engineers state that the use of their new car will eliminate handsealing, free the car from rip track and reduce the number of cars needed to handle the same tonnage as is presently being moved.



Caterpillar Tractor Introduces Three Sizes of the Wheeled Traxcavator (3)

MAJOR FEATURES and product details of the Caterpillar Tractor Co. No. 922, 944 and 966 Traxcavators—first of an all new line of wheeled loaders for the company—have been released. The design is a marked departure from other wheeled front-end loaders according to the company, the most apparent feature being the location of all lift arms and cylinders ahead and away from the operators' compartment. Model No. 922 is available in either a four-cylinder, turbocharged diesel or a six-cylinder gasoline engine. Bucket size will be 1¼-cu yd.

Powered by either a gasoline or diesel engine, the No. 944 is fitted with a 2-cu yd bucket and an engine rated at 105 hp (net). No. 966, the largest machine of the three, is powered by a six cylinder turbocharged diesel and has a 2¾-cu yd bucket. Road speeds vary with the vehicle's size—No. 922 has top speed of 32.2 mph (in reverse); No. 944, 30.0 and No. 966, 27.5 mph. All machines are geared through the transmission to provide 25% greater travel speeds in reverse, a factor which is claimed to reduce cycle times sharply. One important feature is the dual braking system. The right-foot brake pedal operates as a normal brake; while the left-foot pedal is tied in with the transmission, and shifts the power into neutral when more than 40-psi brake pressure is applied to the pedal.

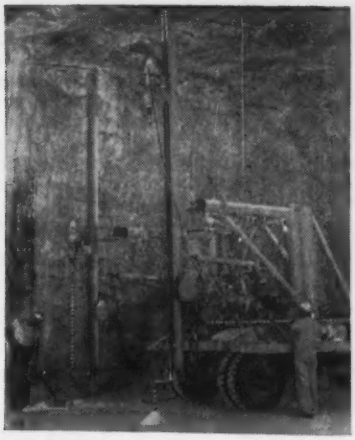
Easy servicing is another feature of the machine. In the operator's compartment, the seat can be tipped forward to protect it from the weather, and to provide access to the transmission filter, control valve and loader pump, and for linkage adjustments. Routine maintenance can be performed without tearing the machine apart.

A side-dump bucket is available in 2-cu yd capacity for the No. 944. The bucket extends 20 in. to the outside of the left front wheel and allows dumping to the left side. A counterweight of 1000 lb is installed inside the frame on top of the standard counterweights.

A light-material bucket with 3-cu yd capacity is recommended for the No. 944 when handling material weighing less than 2,000 lb per cu yd. A fiberglass cab equipped with wide entry doors, windshield wiper and safety glass is available.

Four Motor Graders Offered by Huber-Warco (4)

FOUR STANDARD transmission motor graders designated Models 8-D, 9-D, 10-D, and 11-D, have been introduced by Huber-Warco Co. following extensive field testing since 1958. The new series retain such Huber-Warco features as box-section single-member frame, patented saddle for complete blade control from the cab, high axle clearance and heavy-duty tandem drive cases. The 8-D is powered by an International UD-370 (83hp); the 9-D by any of three 100-hp units—International UD-14A, GM 3-71 or Cummins J-6-BI; the 10-D by either an International UD-554, GM 4-71 or Cummins NHC-4-BI (each develops 125hp); and the 11-D is powered by Cummins H-6-BI at 160 hp.



Drilling Rig (5)

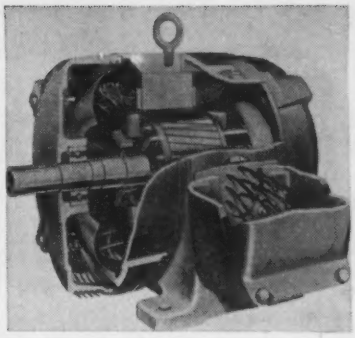
DRILLING of holes in almost pure salt has been greatly simplified by this truck-mounted rig, and less explosives are required in Morton Salt Co. mine at Weeks Islands, La. The drill rig was specially designed for Morton Salt by Landis Steel Co. to enable efficient use of Kennametal threaded sectional augers. Hard carbide drill bits (2-in. dia) penetrate to a depth of 34-ft at a rate of 10 fpm. Seven 34-ft holes supersede 120 face-drilled horizontal holes (10-ft) and enable breaking out 900 tons of salt with only 60% as much explosives. A 50-ft bench of salt on which the rig rests was undercut by a cutting chain with another type of Kennametal bit on a 9-ft horizontal bar before blasting. This is done to maintain level floors for mobile machinery. Morton's salt mining operation is 750 ft below ground in a salt column at least four miles deep with cross-sectional area of three to four sq miles. The salt, at least 99.7% pure NaCl, is used in the chemical industry.

Bin Level Indicators (6)

MATERIAL-LEVEL indicators are now designed for hazardous dust locations, as well as for general purpose use according to Fuller Co. The announcement was made upon approval by Underwriters' Laboratories, Inc., (UL) of the Fuller Model SG-4X for use on hazardous dust locations (Class II, Groups E, F and G). Model SG-4 is designed for all general purpose applications.

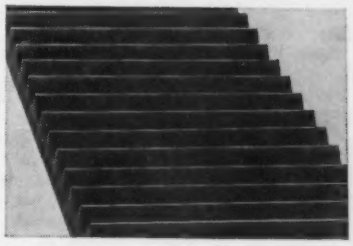
The models are identical in operation and dimensions. They contain interchangeable parts and wiring, except that Model SG-4 contains a gasket between the cover and the body, while Model SG-4X has metal-to-metal surfaces and a paddle shaft bushing machined to UL specifications.

These Fuller material-level indicators may be used to indicate the level of pulverized, fine, crushed or granular materials (maximum 1 in.) in bins and silos. They also are used to control such equipment as feeders, valves, elevators and conveyors. They exercise this control by starting or stopping the motor driving the equipment when a predetermined material level is reached.



Squirrel-Cage Motors (7)

A LINE of squirrel cage Life-Line A motors from 3 to 75 hp is now available from the Westinghouse Electric Corp. These motors are designed for outdoor oil field pumping service. The motors provide top performance over a wide voltage range. Low magnetizing current assures high power factor even at overvoltage. High starting torque provides positive "breakaway" even on low voltage under the most severe conditions of "sticky" loads and icing. Both the stator and rotor are designed to handle short time overloads. The temperature rating is 10 below the maximum values of industry accepted standards. "Full bar" construction is used in the rotor to assure maximum rotor thermal capacity.

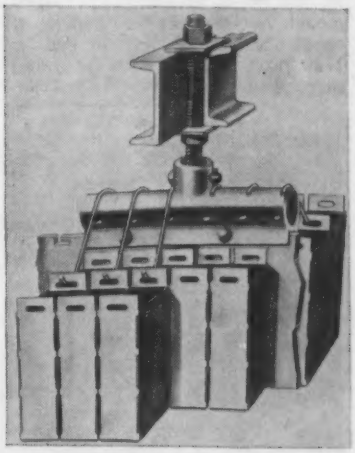


Inclined Belt Conveyor (8)

DUR-A-LIFT, a new incline conveyor belt is now being offered by Boston Woven Hose & Rubber Co., Div. of American Biltrite Rubber Co. The Dur-a-lift belt is recommended for carrying objects up an incline as steep as 45° and will actually carry some objects to 50° incline. It will convey smooth, rough, or slippery objects without sliding, and has been test-proven to have greater ability to convey than any other commercial package belt. The top cover consists of parallel, transverse, inverted "V" ridges of wear-resistant Dulon. The exclusive Dulon covers made the Dur-a-lift belt more resistant to abrasion gouging, tearing, and oxidation. The deep "V" ridges are self-cleaning and assure maximum grip action at all times. Dur-a-lift belting also features balanced belt construction which equalizes ply stress so that each ply of the belt pulls its full share of the load. The new belt is available in three or four ply, 28 oz duck. It is manufactured and stocked in 48-in. rolls, 500 ft long, and may be cut to other widths.

Anti-Stalling Additive (10)

A SPECIAL GROUP of aliphatic surface-active agents has been found beneficial in reducing stalling of automobile engines, according to the Armour Industrial Chemical Co. In addition to their effectiveness as anti-stalling agents, these chemicals are useful as corrosion inhibitors, anti-fouling agents and as detergents. They are effective in low concentrations at a cost of as little as 7 to 15 mills per barrel of gasoline. The Armour chemicals which have proved most effective for this use are tradenamed Duomeens, Ethomeens and a special new derivative identified at present as RD-3063-P.



Basic Refractory Brick (17)

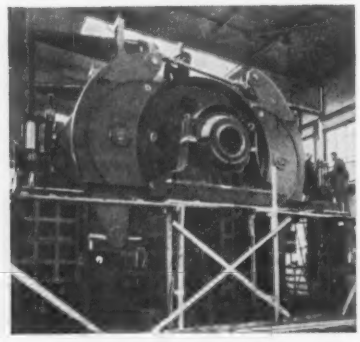
AN ALL BASIC open hearth furnace using Porter basic refractory brick has been shown by H. K. Porter Co., Inc., Refractory Div. This new concept in roof and end-wall suspension employs the present fundamental construction now in use. Bricks are individually wrapped in metal, rather than being fitted to preshaped cases, to provide proper expansion space. Porter roof suspension has these advantages: A built-in air-cleaning and air-cooling system, which covers the entire roof; simple inexpensive tab supports for brick; and notched tie plates that slip into place and anchor to pipes for positive support. Because extended use of basic refractories enables furnaces to operate at higher temperatures, oxygen lances are incorporated into the roof design.

Vibrating Feeders (19)

VIBRATING feeders (motorized counterweight) with twin motor vibrator drives can be cable suspended or floor mounted to feed a wide range of bulk materials at tonnages up to 1700 tph are available from Link-Belt. This MC line features 31 completely new sizes in feeder lengths from 6 to 14 ft, and trough widths from 1 to 6 ft. Both types are available with special modifications such as feeders with predesigned hoppers, scalping decks and live-bottom hoppers.

Cutter-Loader Casts up to 1750 yards/hour (9)

LOADING SCRAPERS, wagons and big trucks with sides up to 15½ ft in height is the special talent of the new Jeb-Loader, announced by Jebco, Inc. The unit mounts on a motor grader and can load up to 800 yards an hour or cast up to 1750 yards an hour, with the conveyor supported by the rubber-tired tandem. A 32-in. dia cutting disk feeds material to a trough-shaped belt, which travels at 614 fpm. The belt is kept free of clinging dirt by scrapers bolted to the conveyor frame. Large crowned pulleys keep the belt centered while vertical guide rollers protect the edges of the wide belt.



Large Friction-Drum Hoist (11)

WHAT IS CLAIMED to be the world's largest mine hoist is being delivered shortly by Asea to the USSR, according to the Swedish company. It is intended for a double hoist system with a loading capacity of 50 tons per skip and forms part of a delivery of nine hoisting units. Still another one is of the same size.

The hoist drum weighs 49 tons and its two skips weigh 40 tons each. For lifting the drum out of the construction hall it was necessary to build a new traversing gear. In spite of the heavy capacity of the pulley unit its diameter is only 14 ft, as its hauling capacity is distributed over eight wires, as against a maximum of four wires in other large-size driving pullies.

The driving speed is 10 33 fps at a depth of 3,000 ft. The motor effect is 9,000 hp, derived from four separate units which are connected to the driving wheels by means of two double-reduction precision gears.

However, the mechanical equipment is designed for an ultimate depth of 4275 ft, which will mean an increase in the driving speed to 46 fps.

Extensible Conveyor (13)

EXTENSIBLE mine conveyor which can operate as long as a week or more without being moved, thereby reducing the down-time associated with conventional conveyors which must be moved frequently to keep pace with continuous mining machinery has been developed by Hewitt-Robins, Inc.

The unit is designed for use in underground coal and hardrock mining. It is comprised of a belt which rides on idlers mounted on sled-like skids spaced at 5-ft intervals. The skids are held in alignment by wire ropes. A conveyor may be constructed with as many as 200 skids, making a unit 1,000 ft long. The equipment is located behind the mine loader which receives material from the continuous mining machine. An electro-hydraulic tractor with crawler traction is attached to each end of the conveyor, exerting constant tension on the belt to keep it taut.

A traveling tripper permits variation in the distance from the conveyor loading point to discharge. Material can be handled at a rate of 400 tph for 70 hours or more without moving the equipment.

Miniature Seismograph (14)

RELIABLE COST ESTIMATES without costly drilling are made available to mining engineers obtaining subsurface information with a miniature engineering seismograph. Manufactured by Geophysical Specialties Company the patented 16-lb electronic instrument provides complete information for precisely determining depth to bedrock, the presence or absence of bedrock or other solid materials.

Operation of the instrument requires only two men and can be handled on foot in any type of terrain. In using the machine, seismic impulses are produced by a sledge hammer. An electronic counter circuit measures the time required for sound waves to travel from the blow of the sledge hammer through the earth to the instrument. Depth and type of material are determined with the instrument readings. Normal depth determinations can be run in 10 to 20 min. Under ordinary conditions, profiles can be completed at the rate of ¾ of a mile per day at a station interval of 200 ft.

Tail Block For 1-in. Rope (15)

A DUROLITE block (8-in.) for use with 1-in. dacron, nylon, manila and polyethylene rope is now available from Sauerman Bros., Inc. The new block weighs only 27 lb. It is equipped with tapered roller bearings, has a wide flange sheave and wide throat housing.

The Durolites can be furnished with a rope bearing swivel eye, pin bearing swivel eye or swivel hook. One of the throat pins may be replaced with a toggle eye bolt for quick opening of the gate without tools.

Wheeled Tractor-Shovel (16)

DESIGNATED the Model PM-440, it is the largest in a completely new line of Speedall tractor shovels now being brought out by Pettibone-Mulliken Corp. The PM-440 has a lifting capacity of 21,000 lb. and a breakout of 24,800 lb.

For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

TWO NEW bulletins covering the company's line of lightweight air- and electric-driven slushers have been published by Joy Mfg. Co. Bulletin No. 76-F describes the Model S-211 (5hp), while slusher model FF-211 is treated in Bulletin 76-G (rated 7½, 10 or 15hp). **(60)**

SAFETY HATS and caps from Willson Products Div., Ray-O-Vac Co. are presented in an eight-page bulletin (W5910). **(61)**

WIRE ROPE bulletin from MacWhyte Wire Rope Co. shows breaking strength in tons and approximate rope weight in lb/ft for the entire MacWhyte line (6025). 4pp. **(62)**

PORTABLE rotary compressor — the Le Roi Div., Westinghouse Air Brake Co. Model 125RG2—of the sliding-vane type that delivers 125 cfm at 100 psi is the subject of a four-page bulletin (P-123C). **(63)**

ROTARY compressor—Model 600 RP from Davey Compressor Co.—delivers 625 cfm at 100psi according to a four-page bulletin (E-263). **(64)**

DIESEL ENGINE catalog from International Harvester Co. discusses the six-cylinder UDT-817 diesel which is available turbocharged (385hp) or naturally aspirated (250-hp). 16pp. (CR-607-I). **(65)**

CONSTRUCTION equipment in the Caterpillar Tractor Co. line is presented briefly in an illustrated 19-page bulltin (33659), providing condensed tables for each type of equipment. **(66)**

HOW TO MAINTAIN a diesel engine is the subject of a 24-page booklet entitled "Ten Maintenance Steps" and available from Cummins Engine Co., Inc. This bulletin is excerpted from DIESEL MAINTENANCE (Bulletin No. 983425) which is for sale from Cummins at $2 per copy. "Ten Steps" is free upon request. **(67)**

HOW RIPPING can increase earth-moving profits is described in an eight-page brochure from Caterpillar Tractor Co. (33557). **(68)**

DRAGLINE or shovel, whichever is preferred, in 6- to 7-cu yd bucket capacity, introduced by Manitowoc employs one engine and torque converter for motion and a second such combination to power the rope drums. Model 4500 Vicon, has no conventional engine throttles—each clutch control lever acts as a throttle. **(69)**

CENTRALIZED lubrication systems in the Farval Div., Eaton Mfg. Co. line are illustrated in a revised 24-page general brochure (No. 26-T). **(70)**

SURFACE ACTIVE AGENTS available from Onyx Oil & Chemical Co. are tabulated in a 24-page bulletin by trade name, active ingredient, activity, state, general use and specific application. **(71)**

MULTIPLE-TUBE COOLER designed by Allis-Chalmers Mfg. Co. is presented on a two-page flyer. Tube coolers are designed to attach to A-C rotary kilns (22B9290). **(72)**

CHAIN AND SPROCKETS from Dodge Mfg. Corp. are tabulated in a 56-page bulletin (A691). Chain couplings, roller chain and Taper-Lock sprockets are covered. **(73)**

HAND TORCHES for gas cutting and welding—outfits, tips and accessories—in the Air Reduction line are presented in a revised 36-page catalog (818). **(74)**

ELECTRODE pocket guide prepared by Air Reduction Sales Co. is a pocket-size catalog (1318) which tells how to select the proper welding electrode based on the metal to be welded, dimensions, current available, welding position, fitup, specific properties desired in the weld, and code requirements. Thorough. 66pp. **(75)**

VALVE catalog (60) announced by Lunkenheimer Co. is complete and comprehensive, including a 24-page valve selector and over 100 pages of engineering data. May be obtained through your local authorized Lunkenheimer representative. 500pp. **(76)**

ROLLING steel doors, grilles and shutters available from R. C. Mahon Co. are illustrated in a 16-page catalog (G-60). **(77)**

(Continued on next page)

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ENGINEERING & MINING JOURNAL
330 WEST 42nd STREET
NEW YORK 36, N. Y.

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Please send me the catalogs or further information about the items from New Products Digest whose numbers are circled.

1	11	21	31	41	51
2	12	22	32	42	52
3	13	23	33	43	53
4	14	24	34	44	54
5	15	25	35	45	55
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DOUBLE TOGGLE jaw crusher manufactured by Allis-Chalmers Mfg. Co. is detailed by enumerating its 21 modern operating advantages in an eight-page bulletin (17B6369E). **(78)**

HORIZONTAL inclined-grate coolers are illustrated in an eight-page bulletin (CO-7) from Fuller Co. **(79)**

SYNCHRONOUS motor bulletin released by Allis-Chalmers Mfg. Co. describes the A-C line which includes ratings above 1 hp per revolution per minute at speeds of 450 rpm or less. Bulletin cites their advantage for grinding mill operation (05B9522). 4pp. **(80)**

HYDRAULIC PUMPS, fluid motors and valves designed by Denison Engineering Div., American Brake Shoe Co. are presented in a 72-page catalog (220). Denison equipment is made for jobs up to 5000 psi. **(81)**

EQUIPMENT for processing — the Fuller-Kenyon pumps, rotary compressors, grate coolers, preheaters, fans, blowers and gas pumps, the Air-Slide conveying system—are illustrated in a 12-page bulletin (G-3C) from the Fuller Co. **(82)**

LOAD CELL weighing system developed by the Howe Scale Co. is featured in a four-page bulletin. **(83)**

HEAVY-DUTY process pumps in Goulds Pumps Inc. line are presented in an eleven-page bulletin (725.5). **(84)**

HOW EFFICIENT handling produced a commercially successful method of extracting iron ore from taconites is the subject of a 12-page bulletin from Fuller Co. **(85)**

NON-SKID FLOOR SURFACING compound developed by Mine Safety Appliances Co. containing grit can be applied on concrete, metal or wood with a roller or brush according to a two-page flyer on Dura-Grip. **(86)**

SLURRY VALVE in 3-, 4-, and 5-in. sizes are available from Everlasting Valve Co. in cast steel or iron bodies according to a two-page flyer. **(87)**

THE ABILITIES and services of Spectrochemical Laboratories, Inc. are presented in a 12-page brochure. Spectrochemical is able to analyze ores, minerals, metals, metal-bearing residues and alloys. **(88)**

WET DUST COLLECTOR bearing the trade mark Hydro-Filter and designed by National Dust Collector Corp. has many advantages according to literature and reprinted articles available. **(89)**

STAINLESS STEEL TUBING booklet from Allegheny Ludlum Steel Corp. gives details on sizes, grades, design data, corrosion resistance and other valuable information. 35pp. **(90)**

ROTAMETERS for corrosion service is the title of an eight-page bulletin (150) which lists materials in which meters can be constructed for various jobs. **(91)**

UNIT AIR FILTERS of the permanent washable type are illustrated in an eleven-page bulletin (207) from American Air Filter Co. **(92)**

VIBRATING SCREENS in the Kelly line from Productive Equipment Corp. are introduced in a series of four-page bulletins. **(93)**

VENTURI-TYPE gas scrubbing equipment manufactured by Schutte & Koerting Co. are displayed in a 12-page bulletin (4R). **(94)**

CHEMICAL resistance of elastomeric lining to solutions and chemicals is the title of an informative six-page bulletin (43055) prepared by the Automotive Rubber Co., Inc. **(95)**

PNEUMATIC transport of materials is described in National Air Conveyor's four-page bulletin on the National system which can move dry flowable solids as well as slurries. **(96)**

BASIC OXYGEN STEEL process is detailed in a 16-page booklet prepared by Kaiser Steel Corp. Method refines steel in minutes rather than hours and has been installed at Fontana, Calif. by Kaiser. **(97)**

SPHERICAL roller bearings and pillow blocks bulletin prepared by Link-Belt is detailed, thorough (2760). 48pp. **(98)**

RUST-OLEUM paint brochure from Rust-Oleum Corp. is informative and well illustrated with color samples of the paints available for each job. 36pp. **(99)**

GEARBELT DRIVES from Browning Mfg. Co. are featured in a 56-page bulletin (GB-201-A) which shows pulleys, belts, engineering data, horsepower ratings, drive tables and drive calculation examples. **(100)**

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This all day sucker . . .

This hose can't kink when twisted, can't flatten when crushed even by the heaviest construction equipment. Acme-Hamilton Suction hose is reinforced with a continuous spiral of special non-metallic resilient reinforcement which gives it built-in bounce! The smooth-bore tube increases rate of flow, reduces turbulence. Costly down-time through accidental crushing is minimized with A — H Cord Suction Hose.

Check these features:

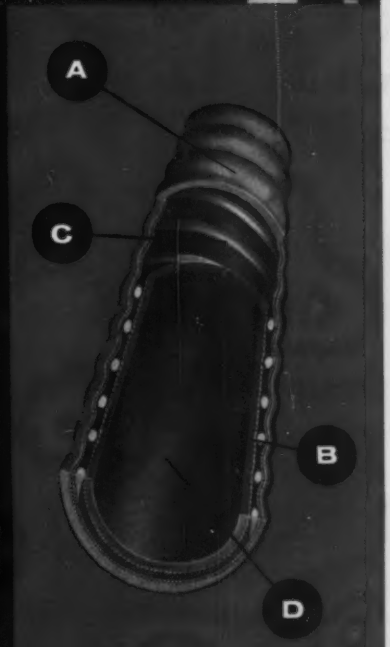
(A) Abrasion resistant red cover.

(B) Cotton duck plies.

(C) Rubber bonded plastic cord in 2½" and 3" sizes only.

(D) Smooth bore tubes.

Specify Acme-Hamilton cord suction hose when you order from your distributor, or write to Acme-Hamilton, Dept. S-3.



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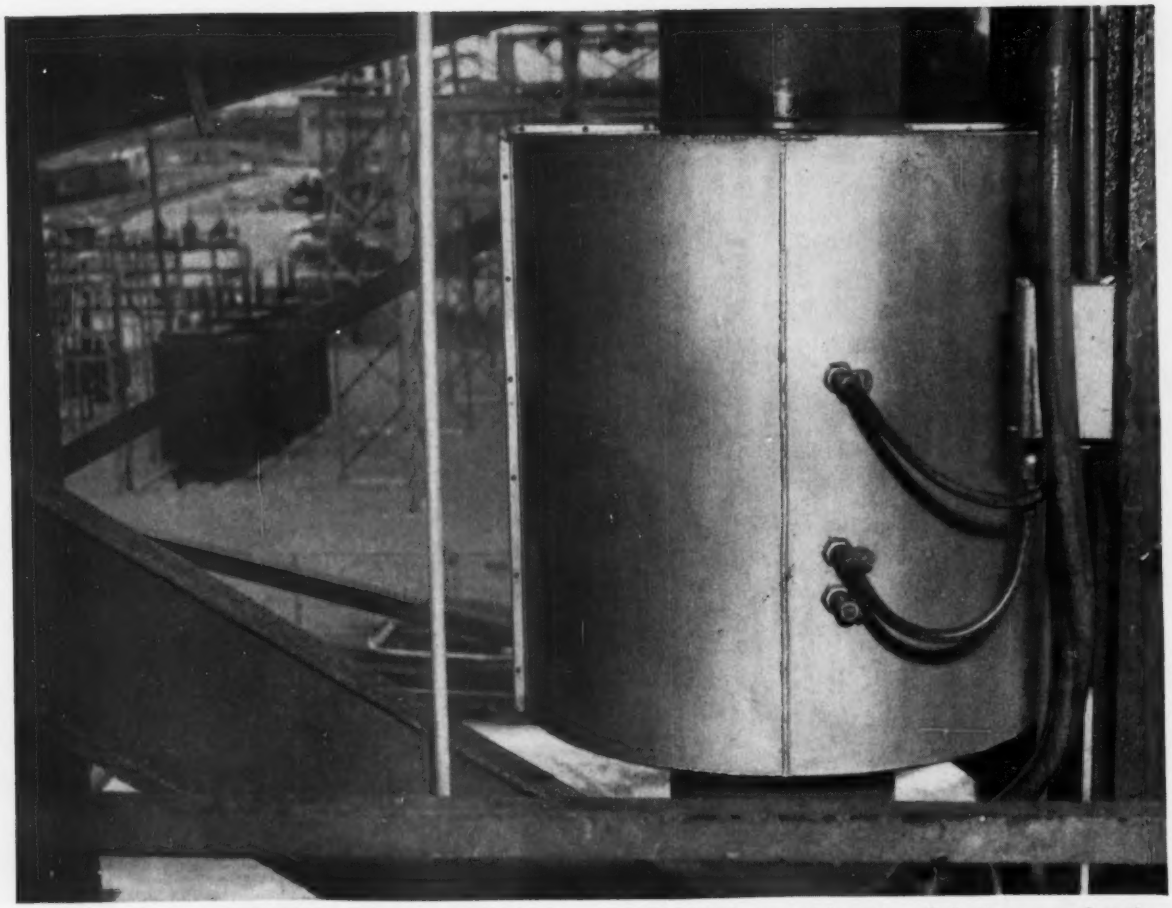
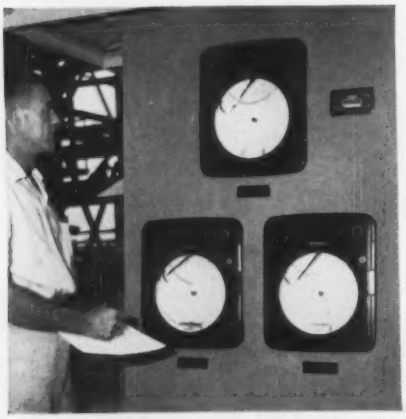


This 16" Foxboro Magnetic Flow Meter meters phosphate rock slurry as simply as water. Magnetic meters have no flow restrictions of any type — measurement is made magnetically from electrodes flush-mounted in meter wall. In three years of continuous operation the only maintenance on this meter has been a liner replacement.

At International Minerals:

Rock slurry metered directly in dry-tons-per-minute thanks to the Foxboro Magnetic Flow Meter



Control panel for International Mineral's Mass Flow System has 3 Foxboro Dynalog* Recorders. Bottom two record pipeline flow and solution density. Product of the two is then recorded on upper Dynalog *directly* in dry-tons-per-minute. *Reg. U.S. Pat. Off.

At The International Minerals & Chemical Corp., Bartow, Florida, phosphate rock slurry is pipelined from the mining operation to the flotation plant 5 miles away. Problem was, how to let mine head operators know how much rock to feed into the pipeline to maintain constant flow.

A mass flow system — based on the Foxboro Magnetic Meter — proved the perfect answer. In this unique system, the Magnetic Meter measures flow in gpm, while a gamma ray cell measures solution density. The product of the two values is then recorded *directly* in dry-tons-per-minute.

Mass flow — pressure — temperature — pH — no matter what your measurement problem, there's a combination of Foxboro instruments to solve it. And there's an industry-trained Foxboro field engineer nearby to help show the way. Call him — or write Foxboro about your problem direct. The Foxboro Company, 193 Norfolk Street, Foxboro, Massachusetts.

FOXBORO

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Crushers with *Gýrol*® Fluid Drive shrug off shock

On crushers, grinders, pulverizers, sizers, and conveyors, Gýrol Fluid Drive from American-Standard* Industrial Division transmits power through a vortex of oil to isolate damaging shock loads and torsional vibrations. Other features of Gýrol Fluid Drive are: smooth, stepless speed control and no-load starting of heavy-inertia loads. There are units available from 1 hp to 12,000 hp. Find out how your operations can benefit from efficient, dependable Gýrol Fluid Drive. Contact our nearest office today. They're located in all principal cities. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.

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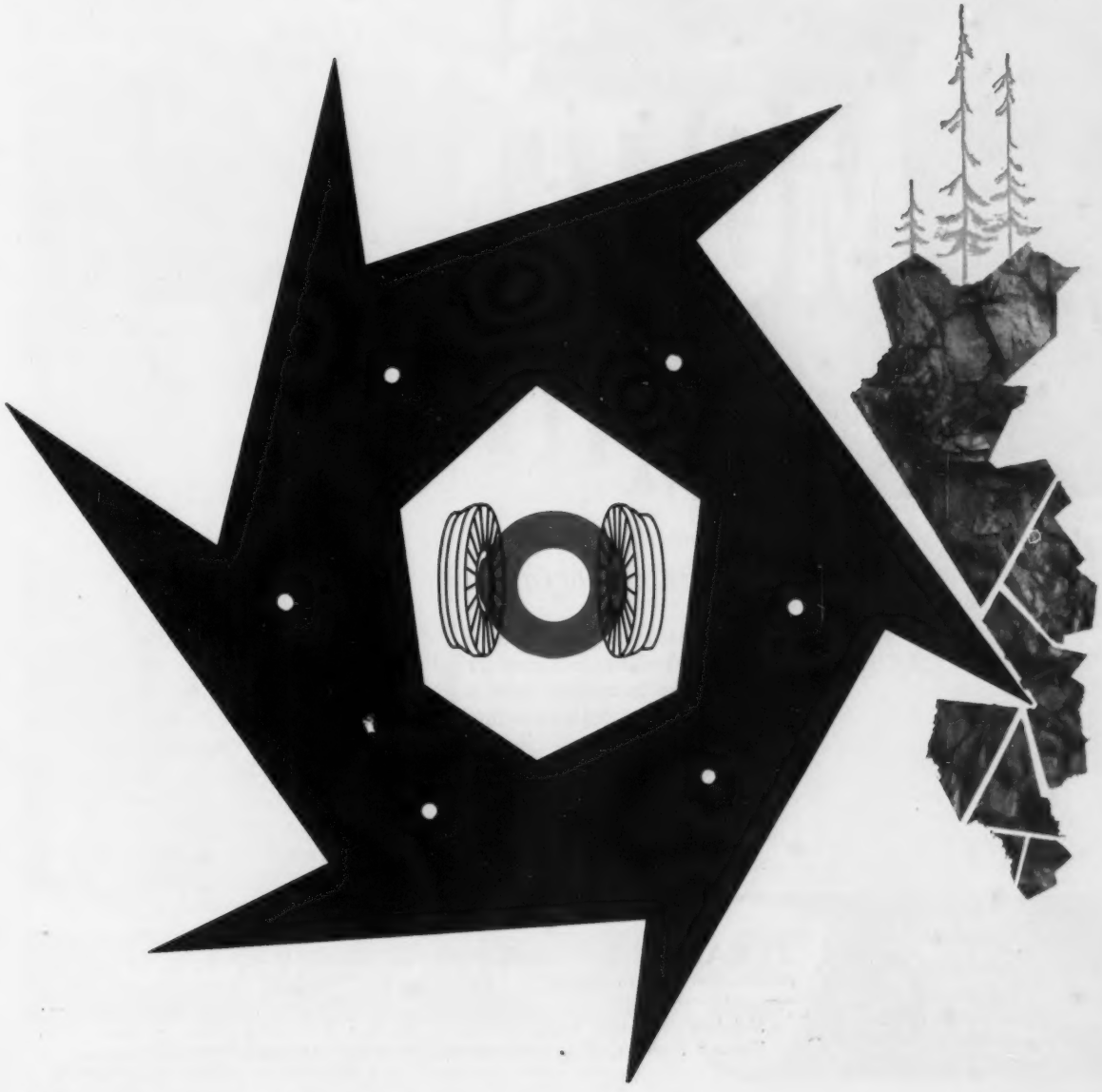

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Loading Tank Cars at one of our mines

...an important phase of TGS Service

This is a service of interest to the rapidly increasing number of companies preferring to receive their sulphur deliveries in molten form so that they can transfer directly from cars into consumption. We are equipped now to deliver molten sulphur by tank car from all mines and recovery plants to any place in the country. Detailed instruction sheets and drawings are available on request for those in the planning stage or who do not have adequate or proper facilities for handling and storing molten sulphur.

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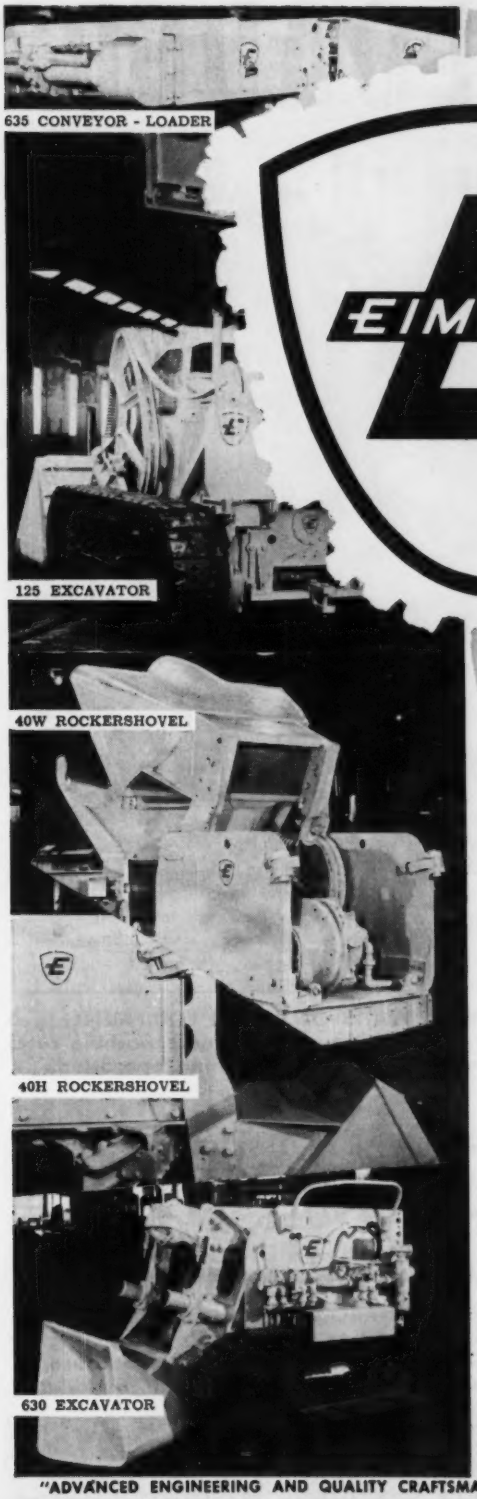

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..... on any underground loading and mining machine is your assurance of increased productivity and lower production costs.

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So why settle for less than the best? It costs no more to specify and buy the standard of quality in underground loading machinery and equipment . . . Eimco Quality.

For details, specifications or qualified engineering assistance, please contact The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah, U.S.A.

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MINING EQUIPMENT DIVISION

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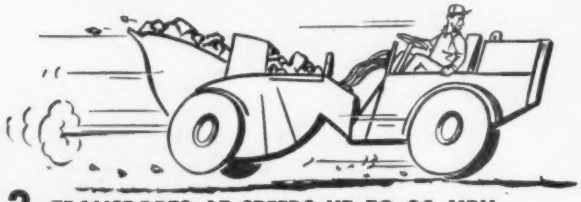
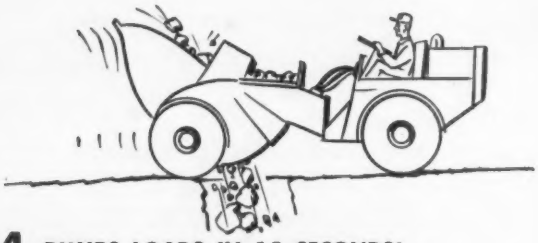
Why TRANSLOADER?

The Only Self-Loading Transport!

1. LOADS 6 TONS IN 49½ SECONDS!



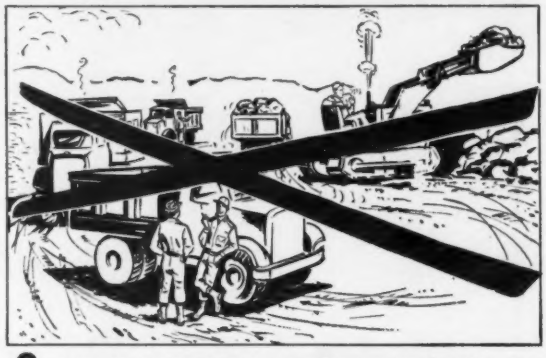
2. TRANSPORTS AT SPEEDS UP TO 23 MPH — *either direction!*



4. DUMPS LOADS IN 15 SECONDS!

THIS IS WHY the S-D Transloader is more efficient than conventional equipment and methods of materials handling. But this is not all. The S-D Transloader way is the **lowest possible cost way** because:

1. **LOWEST ORIGINAL COST** for tons handled!
2. **LOWEST MAINTENANCE** due to extremely simple design and high quality of components . . . such as T-1 Steel, Cummings Engines, Clark Axles, Allison Transmissions!
3. **LEAST VENTILATION** required underground due to low horsepower ratio to work-done!
4. **LOWEST LABOR COST PER TON!** Incentive systems fit the S-D Transloader like a glove because of solo operation! Nothing could be neater than an operator loading and running a known distance to discharge **by himself!** This RELEASES SUPERVISION! S-D Transloader also ELIMINATES TASK OF TRYING TO BALANCE MEN AND EQUIPMENT WITH CONSTANTLY CHANGING SITUATIONS!



3. NEVER WAITS ON OTHER EQUIPMENT! S-D Transloader saves labor and machine costs wasted in multiple machine operation.

5. NO TURNAROUNDS REQUIRED! Returns immediately to reload! Travels at higher speeds than other equipment because of low center of gravity and articulated steering!

Write us today for Complete Packet of illustrated literature, data and time studies on this remarkable machine —

THE ONLY SELF-LOADING TRANSPORT! Sanford-Day Iron Works, Inc., Dale Avenue, Knoxville, Tennessee. Telephone: 3-4191

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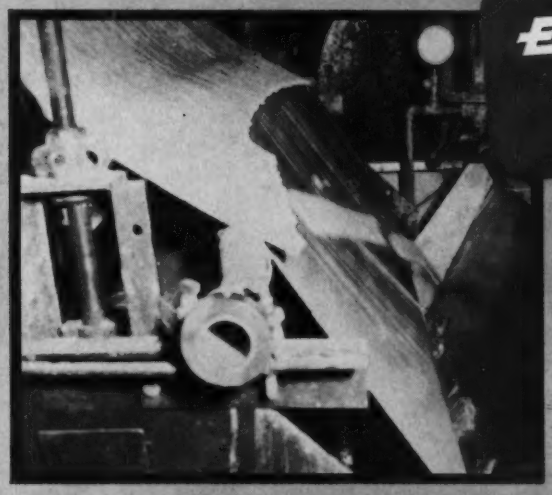

EIMCOBELT
Continuous Belt Drum Filter

Paid for Itself in 3 Weeks!

Extra product recovered added up to approximately $358,000 in extra profits the first year when a mining operator replaced a standard drum filter with an EimcoBelt for cobalt recovery.

With the old filter, recovery had been poor. Blinding was so severe that filtration sometimes had to be stopped after only two drum revolutions for cloth cleaning. There were times when hand scrubbing of the drum cover was necessary.

The EimcoBelt, because it maintains a constantly clean cloth filter medium, handles this difficult cobalt sulphate solution continuously, with no stoppages caused by progressive blinding.

Added product recovery, with the stainless steel EimcoBelt filter, amounts to 562 more pounds of valuable cobalt every day — an added profit of about $358,000 a year for this processor!

EimcoBelt filter's new operating principle removes the cloth or metallic filter medium from the drum every filter cycle for cake discharge and cloth cleaning. Filter medium always returns to drum completely clean.

Freedom from blinding makes it possible, for the first time, to filter slurries that have never been filtered successfully on vacuum filters.

Even slurries having low solids concentrations, which ordinarily require thickening, have been filtered directly, with EimcoBelt.

Contact the Eimco representative in your area for more facts. Write Eimco Filter Division for new Bulletin F-2053.

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About HOMESTAKE metallurgy

Since 1878 Homestake has treated some 85,600,000 tons of ore yielding upwards of 23,000,000 ounces of gold valued at more than $800,000,000 at the current Mint price. Homestake is a brilliant example of continuous study and change of both mining and milling techniques to offset rising costs.

Originally a stamp mill-amalgamation operation, Homestake pioneered the use of cyanidation soon after the turn of the century through the original work of C. W. Merrill. While the complex geologic structure and distribution of the ore was deciphered over the years, metallurgy, too,has been steadily improved.

Homestake recovers 71.5% of values from 4750 t.p.d. by amalgamation after wet grinding through 80 mesh. Sand and slime fractions, about 55% and 45% respectively, are separated by bowl classifiers and cyclones, and treated separately.

Sands with heads averaging 0.115 oz./ton are batch leached with AERO Brand Cyanide solution. Consumption is 0.42 lb/ton NaCN equivalent. Residues average 0.012 oz. and 17% of total head values are recovered in this step. Slimes at 0.070 oz./ton are cyanided in a separate plant with AERO Brand Cyanide solution. Consumption is 0.30 lb/ton NaCN equivalent. Slime residues average 0.006 oz. Values recovered from slimes are 8.5% of total head values in the ore.

Since ore treated assays 0.333 oz. and combined residues average less than 0.010 oz./ton, overall recovery exceeds 97%. Cyanide consumption is 0.35 to 0.40 lb. NaCN equivalent and lime consumption only 2.4 lb. per ton.

The REAL DEL MONTE story

Worked continuously since the days of Moctezuma, Real del Monte is probably the world's oldest major silver producer. Here the Patio Process was conceived by a Pachuca miner in 1557 and used until supplanted by cyanidation in the early 1900's.

Today Real del Monte treats ore from several deposits; 1400 t.p.d. by cyanidation alone, 1000 t.p.d. by flotation. Ore averaging 253 gm. Ag, 1.26 gm. Au per metric ton and low in base metals goes directly to cyanidation. This ore is ground in an AERO Brand Cyanide solution, maintained at a solution strength of 1.30 kilos NaCN equivalent per metric ton. Overall plant recovery of silver is 83.0% with cyanide consumption of 0.65 kilos NaCN equivalent per metric ton.

Base-metal ore containing precious-metal values is concentrated with Cyanamid flotation reagents. Pb, Zn and Fe concentrates are produced. Tails are cycloned and the 550 t.p.d. underflow is pumped to the cyanide grinding section for treatment with the cyanide feed. Zinc concentrates, cyanided separately, assay 5.0 kilos Ag per metric ton prior to cyanidation; 300 gm. Ag after treatment.

Real del Monte is an excellent example of a very old property that has continuously improved its metallurgy as new ore bodies have been opened and discarded tailings from earlier generations have been reworked with modern beneficiation methods.

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You can depend on it. Sheffield's alloying, forging and heat treating techniques assure a uniformly dense grain structure—a fine balance of hardness and toughness—right to the very core of every Moly-Cop Ball. That's why Moly-Cops retain their sphericity longer, to give you a better, longer grind at the lowest cost per ton.

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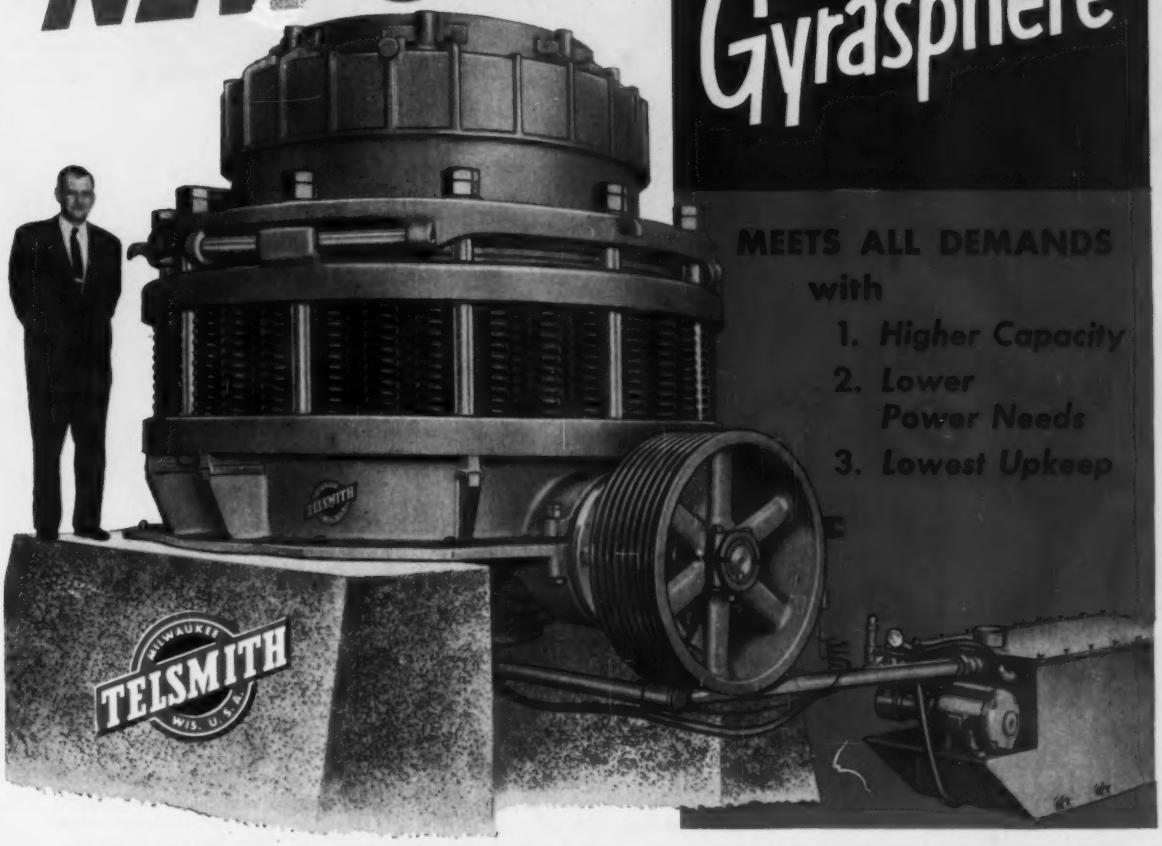

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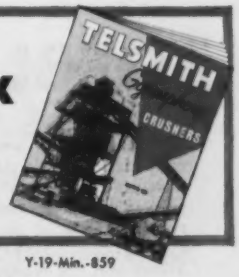

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The Colorado Fuel and Iron Corporation

"We tried several big haulers... and the 65 Payhauler® tops 'em all!"

—New Hope Crushed Stone & Lime Co., New Hope, Pa.

New Hope's "65's" speed full 19-ton loads of dolomite from quarry to 300-ton-per-hr. capacity crusher—with a maximum climb-out grade of 16% and an 800-ft. haul! The 250-hp "65" travels up to 36 mph.; the 375-hp "95" up to 38 mph.!

"Before buying two International® 65 Payhauler trucks, we had demonstrations by several large haulers," reports Edgar N. Putnam, for New Hope Crushed Stone & Lime Co.

"The '65' topped them all for production, ease of operation, and all-around efficiency. Main '65' features are ample power, balance for full-load delivery, and genuine operating ease and safety."

Both the 19-ton 65, and 27-ton 95 Payhauler trucks have the strength-multiplying International corrugated body design—that sheds weight, increases capacity. The direct-start International "817" engine super-powers both "65" and "95"—to outspeed former models, up to 40%. And both "65" and "95" highball full loads safely with reserve-area braking and new course-holding power-steering!

Compare—prove on the job that Payhauler gives you top off-road capacity; top power-to-weight ratio; top profit-earning ability! Let your International Construction Equipment Distributor demonstrate!

Get 11-second Payhauler dumping with exclusive inverted hoist body-positioning. Positive up-and-down snubbing control prevents machine-mauling dumping impact!

International®
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International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

How granite-bucking TD-20 wins tough quarry job!

—for Superior Stone Company, Crabtree Creek Quarry, Raleigh, North Carolina

Main reason why it's a TD-20 instead of some competitive rig: the more powerful, stronger-built "20" replaces a past model International TD-18—that set a stand-out record of high availability and low upkeep at this quarry!

The "20" is key equipment in helping feed the 200-ton-per-hour capacity crushing plant at Crabtree Creek Quarry of Superior Stone Company (Division of American Marietta Company).

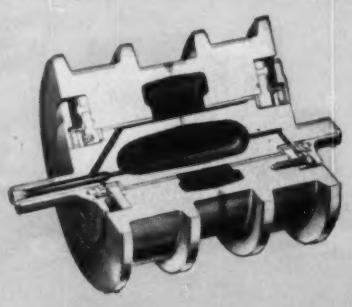
Slamming hard, heavy granite stone around is a main item on this International TD-20's work diet. That and tough over-burden removal, and haul-road maintenance!

"Rock-Bossing" power and strength

The TD-20's engine is a high-torque 134-hp diesel—with 6-cylinder smoothness and International diesel starting ease and economy. Bridge-strong track frames of heavy-duty, gusset-braced, welded box sections form the TD-20's rock-shock-resistant undercarriage.

Exclusive International 3-point-mounting allows free track oscillation for rough mine and quarry duty—and maintains positive, life-prolonging alignment. TD-20 weight rides smoothly on thick-shelled Dura-Rollers—the dual-protected track rollers that make, 1,000-hr. lube intervals practical!

Compare TD-20 performance to anything else on tracks—for capacity, economy, and long life. Measure production-boosting features like "single-stick" shift, 6-speed full-reverse transmission; and cycle-speeding Shuttle-Bar control. See your International Construction Equipment Distributor for a demonstration.



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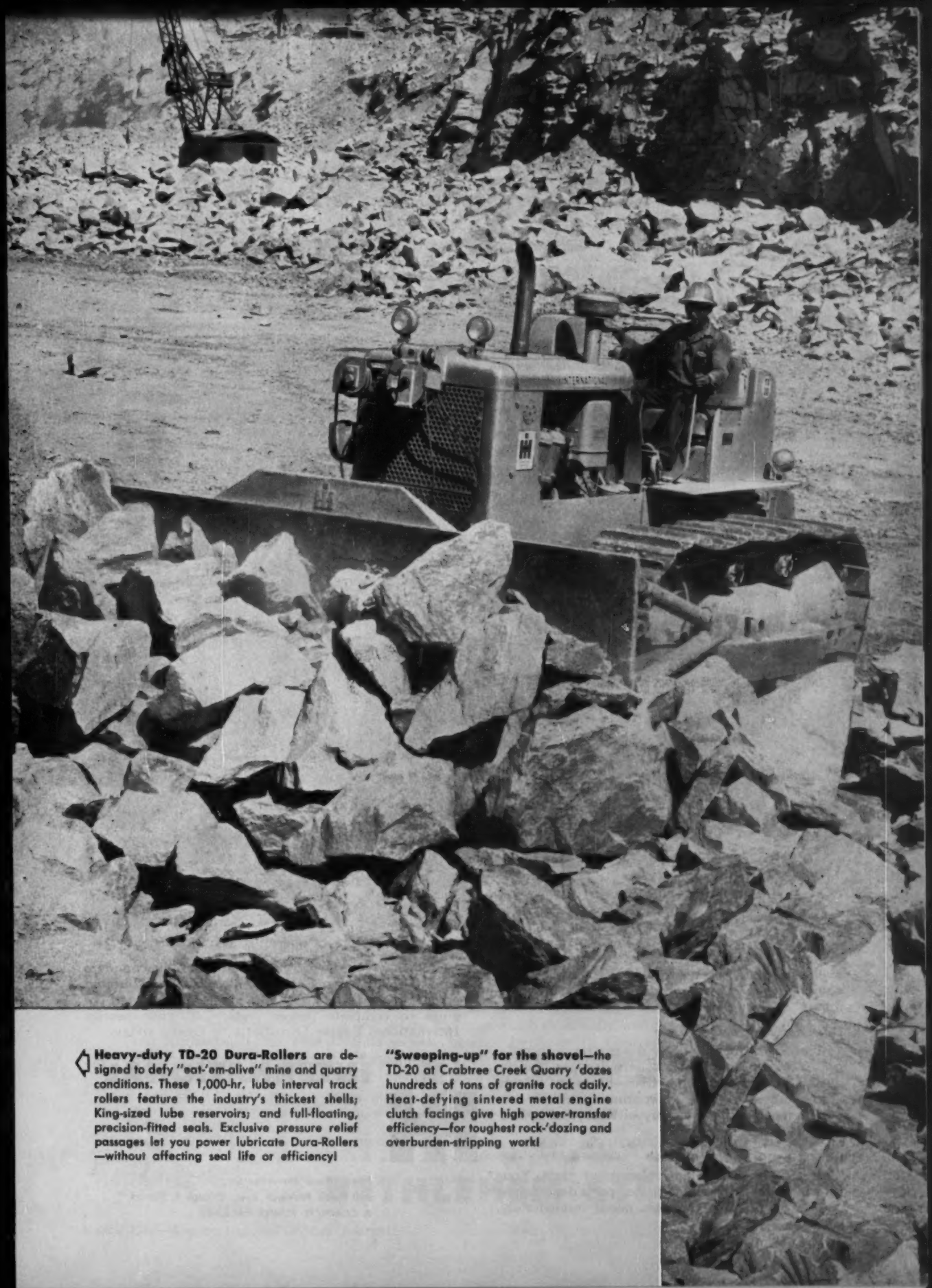


Heavy-duty TD-20 Dura-Rollers are designed to defy "eat-'em-alive" mine and quarry conditions. These 1,000-hr. lube interval track rollers feature the industry's thickest shells; King-sized lube reservoirs; and full-floating, precision-fitted seals. Exclusive pressure relief passages let you power lubricate Dura-Rollers —without affecting seal life or efficiency!

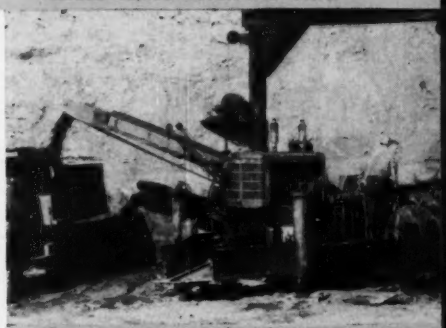
"Sweeping-up" for the shovel—the TD-20 at Crabtree Creek Quarry 'dozes hundreds of tons of granite rock daily. Heat-defying sintered metal engine clutch facings give high power-transfer efficiency—for toughest rock-'dozing and overburden-stripping work!

The Simplot Corp. relies on International power to keep phosphate hauling on schedule in Idaho.

Taylor Exploration Co. gets water for uranium reduction mill in Wyoming with IH powered 11-in. drill.

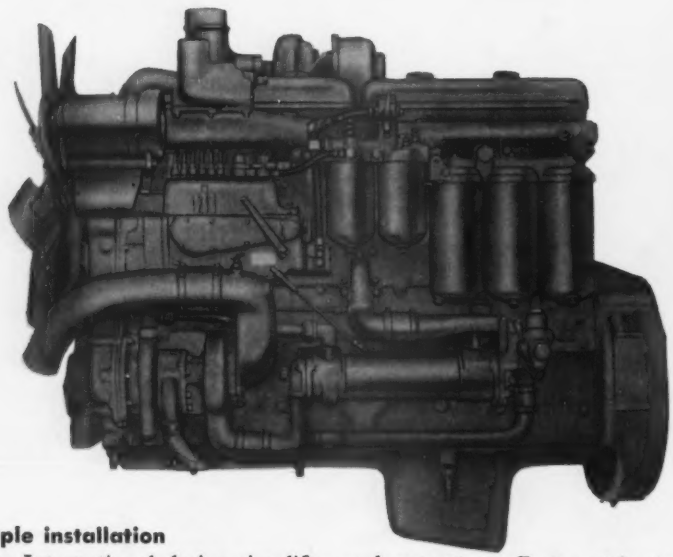
Roy Baker re-powered with International after his UD-24 recorded 20,000 trouble-free hours.

WHY IT'S WISE TO specify International when re-powering YOUR EQUIPMENT



Excavators, Inc. speed coal mining operations with International power on a 42-in. auger in W. Va.

Superbar Co., Inc. mines barite ore from a Missouri pit with shovel powered by rugged IH diesel.



New turbocharged International UDT-817, the lowest priced engine in its size class in dollars per horsepower.

Simple installation

Now, International design simplifies replacement power installation. Your International Engine Distributor will help you with re-powering plans, and show you how the broad IH line can match the engine to the job. There's no underpowering or overpowering, and a variety of IH-built accessory equipment gives you options to meet all requirements.

Dependable performance

International dependability is a matter of record—power for drills, shovels, crushers, dredges, haulers, augers, generators, locomotives—on every mining application, owners report continuous trouble-free performance under a variety of loads and operating conditions.

Reliable parts and service

There is no waiting for replacement parts. Your International Engine Distributor parts department is stocked to fill your parts needs immediately. Parts not in stock are available overnight from one of 12 International Harvester Parts Depots. And his service shop and field service facilities are geared to keep your equipment operating at peak efficiency.

It will pay you to get full details on the complete International engine line—32 diesel and carbureted engines from 16.8 to 385 max. hp.—from stripped engines to complete power units. Call your nearby International Engine Distributor or Dealer today.

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Drill Steel Bores Sandstone in Foothills of Great Smokies

This crawler-mounted drilling equipment, using Bethlehem Hollow Drill Steel, is boring blast holes for the Pigeon River Project, a new 4-lane highway which eventually will connect Asheville, N. C., and Knoxville, Tenn. This 3.6-mile section, handled by Asheville Contracting Co., called for the removal of some 650,000 cu yd of medium-hard, abrasive sandstone. Even with the blast holes from 20 ft to 40 ft deep, the drilling went smoothly; costs were kept low. Bethlehem Hollow, in Carbon and Ultra-Alloy grades, was furnished and reconditioned by Brunner and Lay Southern, Inc. This drill steel is at its best in jobs like this, where the drilling is tough, day after day.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
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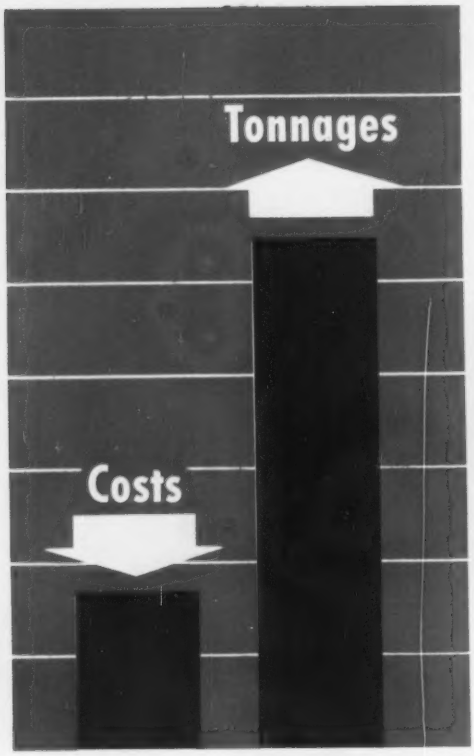

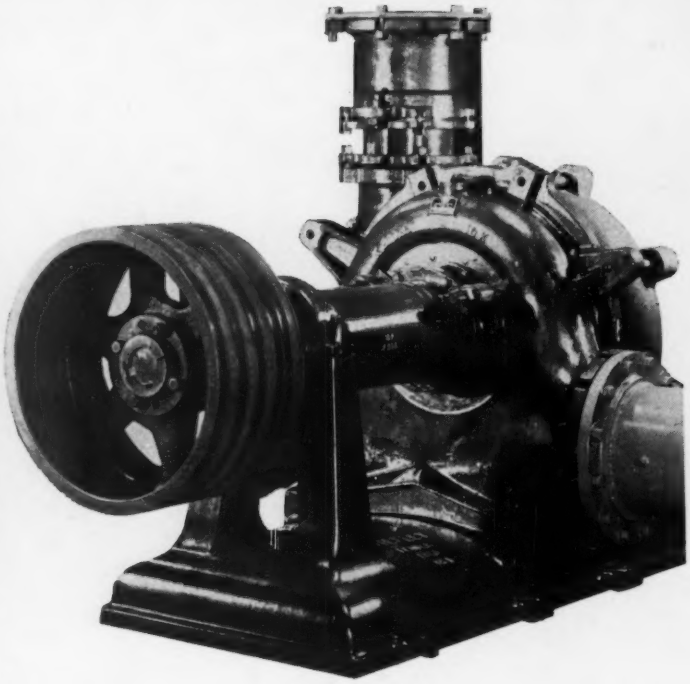

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Put a Wilfley Sand Pump to work—it guarantees continuous, maintenance-free service, stepped-up production, longer pump life, and quick, easy replacement of parts.

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ENGINEERING AND MINING JOURNAL

MARCH 1960

The Changing Role of the Mining Engineer

EDUCATORS AND LEADERS in the mining industry exchanged constructive views at a session of the Committee on Education of the Society of Mining Engineers, AIME, in New York in February.

H. R. Rice, of the University of Toronto, observed that young engineers are becoming more security minded. Because of the transient nature of mining engineering, he suggested that mining companies consider establishing "an imaginative industry-wide portable pension scheme to include associated benefits, which would embrace all technologists in large and small units alike, and regardless of lengths of service with any particular employer." Rice noted that other industries are "taking a hard look at portable pension schemes," and expressed the belief that pensions are not a gratuitous reward for long service, but are, instead, deferred compensation for all service.

Charles Brinckerhoff, president of the Anaconda Co., said that overseas opportunities for engineers still exist, but in many lands it is becoming increasingly difficult for a young engineer to receive permission to enter and work in his profession. He said this was due in part to the very creditable job which nationals or citizens of host nations are doing in the field of mining.

"The need for the old concept of mining engineer, trained broadly in many fields, has greatly decreased," Brinckerhoff said, and in his place "we need engineers with more training, capable either of specializing, or of developing eventually into administrative work in any branch of the extractive industries."

Brinckerhoff recommended that courses be revised to give a student the degree of "Engineer." He suggested that the training be accelerated by giving a three-year course of three semesters each year which would primarily include concentrated courses in basic engineering, and opportunity for electives in geology, mining, metallurgy, industrial chemistry, metal fabricating, petroleum engineering and the engineering of nonmetallic minerals. Such a curriculum would leave room, he said, for post-graduate work in advanced geology, metallurgy, ore dressing, chemistry and automation. He suggested that a degree in these specialized fields be granted after completion of two years work in addition to the three-year basic engineering course.

S. D. Michaelson, of Kennecott Copper Corp., and former president of the Society of Mining Engineers, AIME, proposed that less emphasis be placed on surveying, sampling or mine layout, because most of that work is actually being done by sub-professionals. Instead, he suggested that courses be revised to include training in basic industrial engineering, principles of long-range planning and budgeting, system analysis and administration, cost control, wage administration and force control techniques. In reviewing the functions of today's mining engineers, Michaelson said that they are concerned with such tasks as making comparative economic analyses, feasibility studies, writing technical and non-technical reports, preparing equipment specifications and recommendations, working with purchasing, scheduling and estimating projects.

Speaking on opportunities for mining engineers, Michaelson said "I would guess that American mining and mining service companies hire well over 3,000 engineers each year. With only about 200 mining graduates in 1958 and more than 3,000 engineers being hired, it should be obvious that plenty of opportunity exists for properly trained engineers in mining."

Two speakers proposed consolidation of mining schools. Michaelson recommended "Improvements in teaching mining by pulling the mining schools together into a few universities with larger classes and stronger resources. Ultimately this will mean sounder financial support from Government, industry and private citizens, and stronger faculties of men with true stature in the field." Roger Pierce, consultant of Salt Lake City, suggested that scattered, thinly populated schools would benefit by consolidating into fewer, well-financed, strategically-located schools. He recommended for instance, that all the schools of Alaska and the Northwest could be consolidated into one strategically-located institution—possibly in the Butte area where many kinds of mining activities can be studied firsthand.

L. J. Parkinson, of the Colorado School of Mines, offered dissenting opinion to the effect that graduates were receiving adequate training in conformance to the needs of industry, and that Colorado graduates regularly receive one or more offers at attractive salaries. Michaelson reported salary statistics showing that mining engineers' starting salaries compare favorably with those offered in oil and the chemical fields.

Although no resolutions were proposed and no action taken at the first session of the Committee on Education, representatives of industry—and some of the educators—felt that there is a decided need to appraise the current mining education system to determine whether it is changing its program effectively to conform to the changing patterns in industry. If educators will undertake a program of critical self-examination, it is EAMJ's belief that industry will cooperate enthusiastically in bringing about constructive changes.

There was some opinion that if the appraisal of mining education is to be entirely objective and unbiased, the investigation might be more properly made by some agency such as the Ford Foundation which has for one of its objectives the pursuit of activities that will sustain national resources for the future of industry.

CAPACITY at the modern and attractive electrolytic plant will be 16,500 tons of refined copper per month by mid-July 1960. Dedication will take place this spring at the site, south of Baltimore in Anne Arundel County, Maryland.

Kennecott Opens Baltimore Refinery

J. W. FRANKLIN

D. P. EIGO

THE NEWEST electrolytic copper refinery in the United States will be dedicated this spring in Anne Arundel County, Maryland, when Kennecott Refining Corp.'s 16,500 ton per month plant will receive its official kick-off.

The $30-million refinery represents another string in Kennecott's bow, for it is a subsidiary of the Kennecott Copper Corp. It will refine blister copper from Braden Copper, in Chile, and from Kennecott operations in the Western States. At the time of the E&MJ's visit in December 1959, the refinery was operating at about 3,000 tons per month output, and suffering from a raw material problem because of the copper strike. Production is expected to reach 10,000 tons per month this month and full 16,500 tons per month operation is due in mid-July.

Construction at the site, south of Baltimore and across the Patapsco River from Bethlehem Steel's Sparrows Point steel works, began in July 1958 with the pouring of the first concrete on the tank house, and production started in September 1959 in that same tank house. Construction was 95% complete at the year-end.

At the head of the line in the refinery are two "melting pot" reverberatory furnaces, among the most modern in the industry and which, Kennecott believes, represent the better parts of other reverberatory furnaces found elsewhere in the United States, Canada and in Africa. The two 400-ton batch-operated furnaces use metal-clad basic brick of standard size for the walls, and silica brick for the floors. They are gas or oil fired. A peel arm crane feeds blister cakes to the reverberatory furnaces.

Anodes supplied to the new refinery may be as high as 99.5% copper, with impurities in the form of sulphur and oxygen plus minor amounts of precious metals.

Standard reverberatory furnace practice is employed, and the molten copper is delivered to the 16-mold casting wheel at about 2,000° F, and cast into Baltimore-lug type anodes. Mold dressing is sprayed on each mold before the cast is made. Anodes are raised by push pins in the usual way, but removal of the anodes from the wheel is by means of a newly designed automatic anode-take-off machine. This machine picks up two anodes at a time and places them on a conveyor chain so that they can be removed by racks on overhead cranes. Anodes are placed in rack type bolsters for movement to the tank house by straddle carriers.

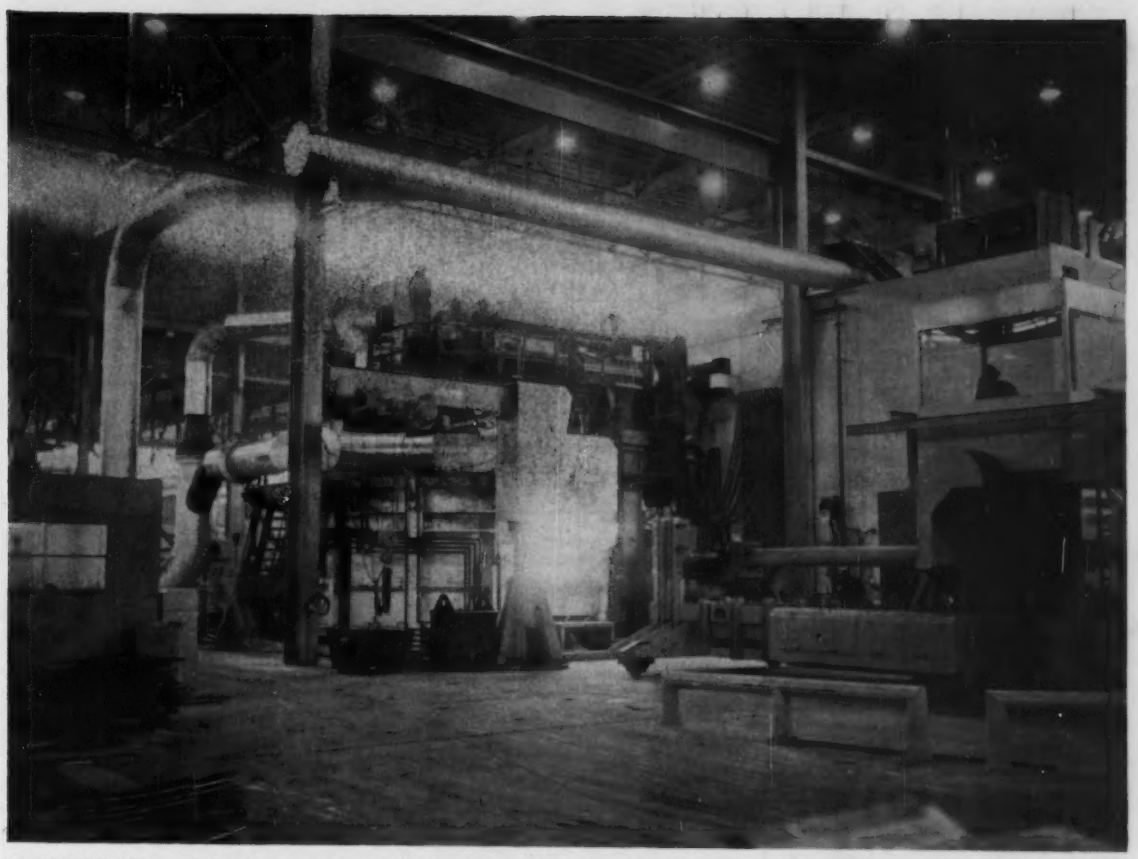
In the tank house, the commercial section has 1,100 cells arranged in the "multiple system." The starter sheet section has 72 cells. Partial decopperization of the electrolyte is done in cells of the commercial section.

Design of the refinery is the most modern to be seen in the East or the West; and, like the new smelter which Kennecott built at Hayden (E&MJ, June 5, 1959, p. 96), provides for future expansion as necessary, and offers the most efficient plant layout for smooth operation anl personnel safety and comfort. Like Hayden, the ceilings at the refinery are high. Ventilation and temperatures are controlled as much as possible, and there is plenty of working room.

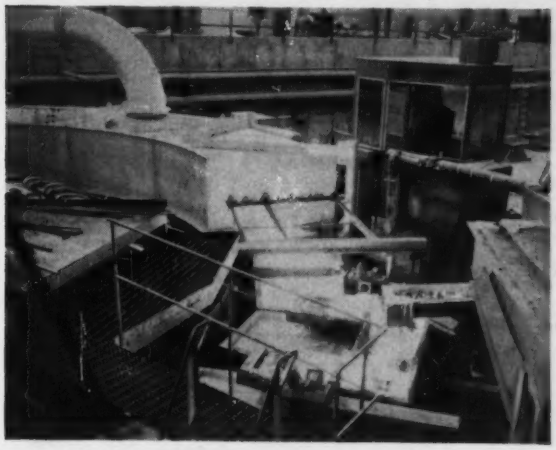
The refinery is arranged to permit easy expansion if it should be required. Changes in building size and increases in refining capability could be accomplished without major alteration to the regular flow of refined metal.

Innovations in product flow and materials handling were designed into the new Refinery by the M. W. Kellogg Co., under the guiding hand of Kennecott engineers. Refinery managers, Ivor G. Pickering, a veteran employee of Kennecott Copper Corp., was formerly chief design engineer at the Western Mining Division's engineering department in Salt Lake City. He was in on the earliest stages of planning the new refinery and, in fact, collaborated in the selection of the site after visiting twenty-five likely spots along the eastern seaboard.

In the starter sheet section, rolled copper blanks are placed between anodes in the various cells. After being in process for 24 hours, each of these blanks has received new copper plated on it sufficient to form two thin starting sheets. The blanks are removed from the cells and a copper sheet is stripped from each side of each blank; these sheets are trimmed in readiness



ELECTRIC-ARC melting furnace takes cathodes from 1400° to 1500° preheater for final refining at approximately 2150°.



THE 16-MOLD WHEEL takes molten metal from the 2,000° F reverb. The plant will receive blister from Chile and the West.

22-TANK SECTIONS in the circuit receive the anodes. Technique is straightforward: anode to starter sheet into cathode.

for the attachment of copper loops. In another area of the starter sheet section, sheet copper loops are attached to the starter sheets in a heavy metal working press, and copper suspension bars are inserted through the loops to support the starting sheets in the electrolytic tanks.

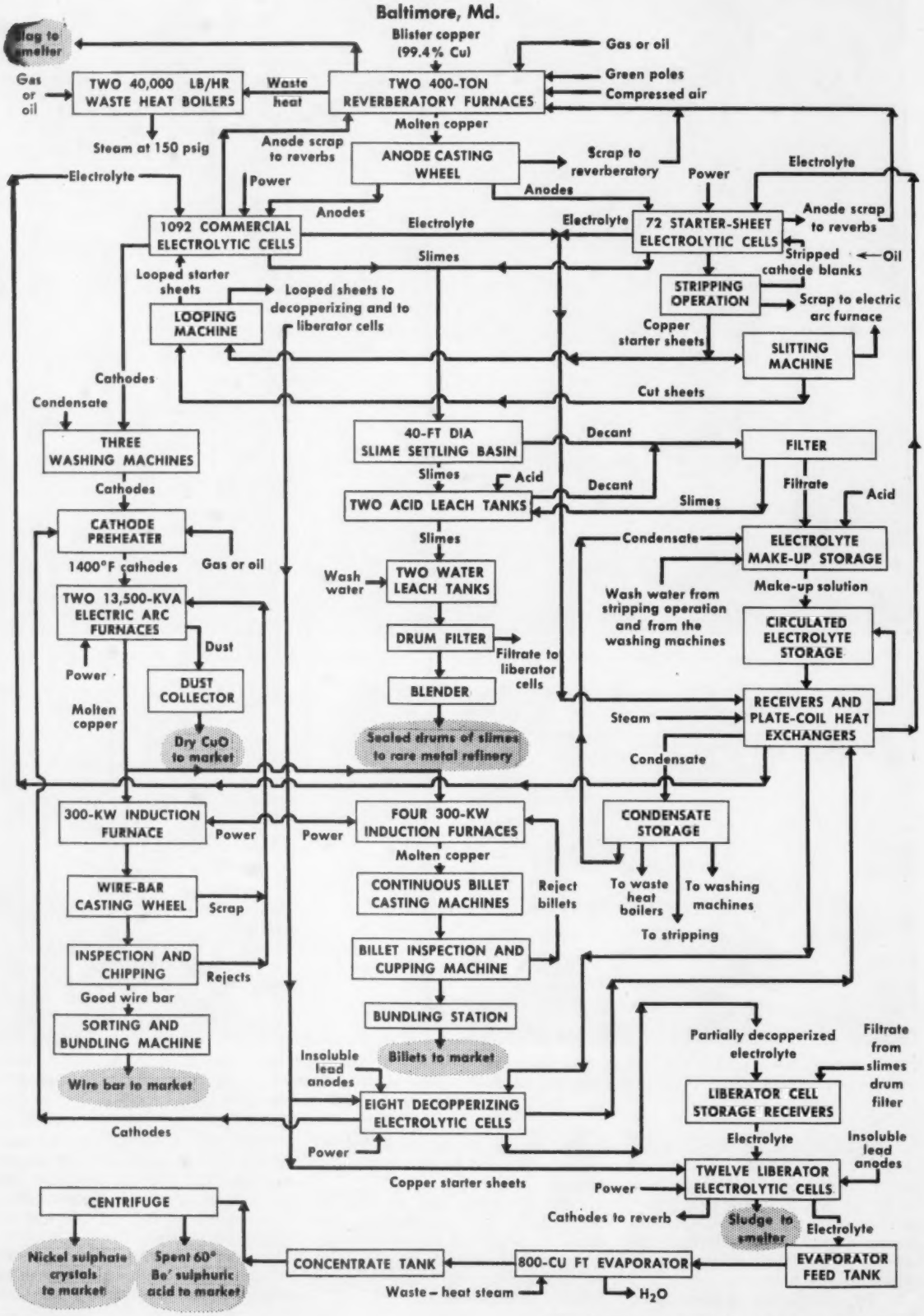
In the commercial sections, these looped starting sheets are placed between anodes and become parts of the cathodes.

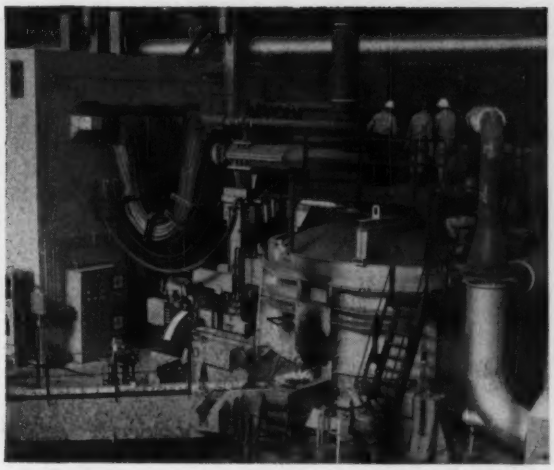
Initial electrolyte was produced at the Refinery from condensate, produced in boilers at the refinery and from small amounts of potable water supplied by the Anne Arundel County Sanitary Commission.

In the starter sheet section, the electrolyte is maintained at 40 gpl copper sulphate, and 150 gpl free acid. In the commercial section, the electrolyte is maintained at 200 gpl acid and 50 gpl copper sulphate.

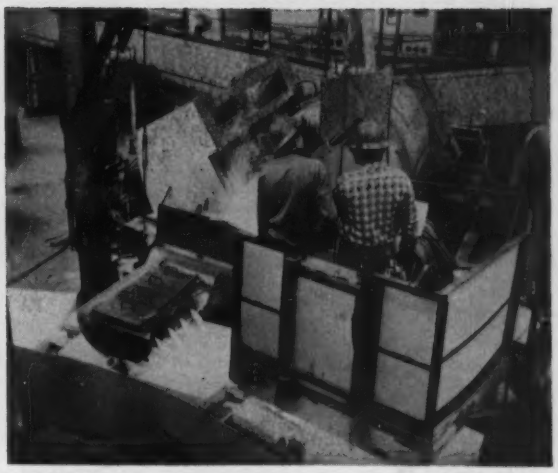
In the electrolyzing process, more copper is taken into solution than is deposited on the cathodes, and the

Copper Refinery Flowsheet
Kennecott Refining Co., Baltimore, Md.

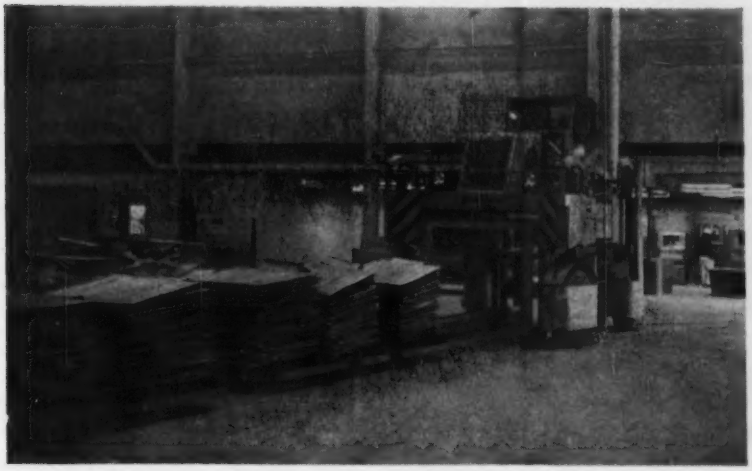




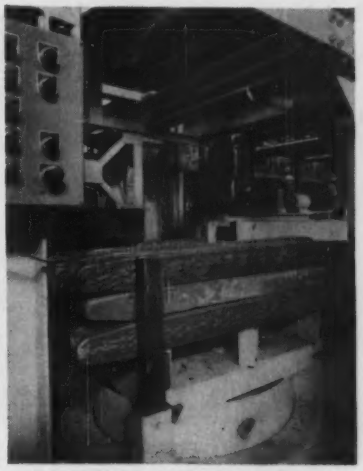
FURNACE contains three 20-in. graphite electrodes, with one replaced each shift. All furnaces are on a five-day basis.



FOLLOWING a hold furnace, the metal is finally cast into wire bars on a horizontal wheel with water cooled molds.



STRADDLE-TRUCK handling of the washed cathodes is typical of the materials handling innovations at the Baltimore plant.



PACKAGING AND BINDING is fast and almost completely automatic.

electrolyte continues to increase in concentration of copper. It is necessary that this copper be removed so that the electrolyte will be kept at the proper level of concentration, and to do this Kennecott uses decopperizing cells in the main tank house. Kennecott has constructed a liberator building in which electrolyte partially decopperized in the main tank house will be stripped of almost all of its copper. The resultant electrolyte will be evaporated to black acid and cooled as shown on the flow sheet to precipitate nickel sulphate. The sulphate crystals will be filtered and washed, and marketed as crude nickel sulphate. The black acid will be sold to other industries in the area.

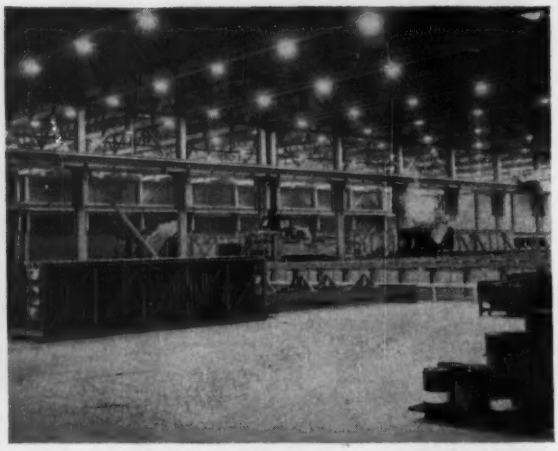
Each of the sections at the new refinery consists of two rows of 22 tanks each. The tanks are fed continuously from a head tank which controls 10 sections. The electrolyte recycles from these cells to 2 electrolyte receivers, each serving 5 sections. All tanks are individual units, and can be removed from the circuit by crane if necessary. Cells are made of concrete, lined with chemical lead (6% antimony) and are fed through rubber hoses attached to a central feed header. Each tank has a bottom discharge for slimes removal.

In the commercial cells, each cell gets two cathode changes for each anode charged. The starting anode weighs 700 lb; each finished cathode weighs approximately 300 lb. The unconsumed anode is removed before it has a chance to break and fall in the tank, and is returned to the reverberatory furnace. Slimes from the cells are washed to a 40 ft diameter slime tank. Liquor overflowing this settler returns to the electrolyte make-up circuit, and the slime is thickened and set to an acid leach tank where much of the copper remaining in the slimes is leached out with sulphuric acid. After the leaching, the slimes are water washed and then filtered on a drum filter and dried, prior to shipment. Dried slimes are packed in drums and shipped to other refineries for recovery of precious metals.

An innovation at the new refinery is the cathode washing machine, found in each bay of the tank house. The cathodes from the cells are placed on the receiving rack of the washing machine, and this rack delivers cathodes to a washing section where electrolyte is washed from the surfaces of the cathode.

Cathodes from the tank house are melted in electric arc furnaces. At this new refinery the cathodes are preheated in a circular gas or oil fired

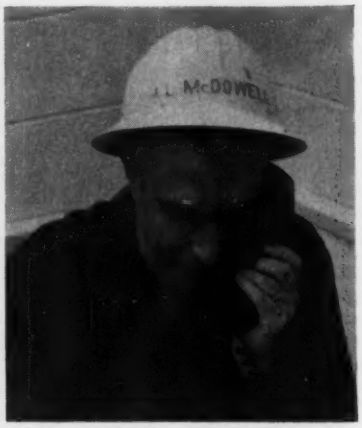
ELECTROLYTE for the initial operations was produced in these tanks. Slimes recovery system tanks are in the background.



THREE WASHING MACHINES designed by M. W. Kellogg receive the sheets. One machine serves each bay.

IVOR G. PICKERING, refinery manager, is a veteran Kennecott employee.

J. D. McIVER, production superintendent, aided the plant from the start.



A. L. McDOWELL, foreman of the anode plant, checks daily progress.

furnace to about 1,400° F. The hot cathode stacks are withdrawn from the furnace, and fed into the arc furnace on a peel arm crane. The arc furnace uses 3-20 in. graphite electrodes, and has a copper bath of about 90 tons. The smooth precision of the arc furnace charging operation is one of the more spectacular scenes in the Refinery. The charging machine retrieves a stack of cathodes from the preheater, turns and moves the stack towards the furnace door. The door slides open and the white-red glow throws a glare against the fork-lifted stack, and beyond to the glass windshield of the charger operator's cab. After the charge of cathodes has been placed in the furnace, sparks spatter a few feet around the opening and the door slowly closes again.

The copper flows from the arc furnace to a small induction holding furnace, and thence to a horizontal wire bar casting wheel. The wire bars are dumped from the molds on the casting wheel in the conventional fashion, and are delivered by a conveyor to an inspection table. The wire bars are stacked and banded into suitable groups, and fork-lift trucks carry the packaged wire bars to the storage areas or directly to box cars or trucks for shipment to customers.

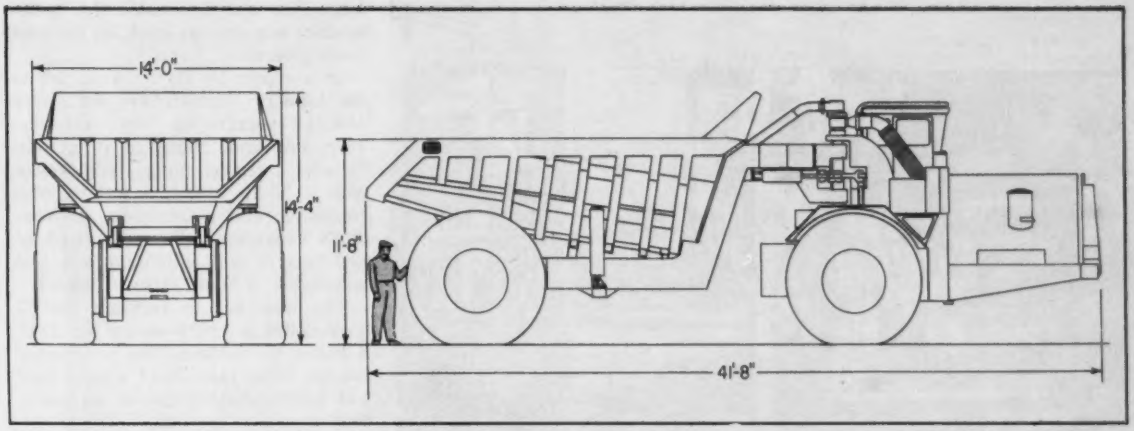
Kennecott's new refinery has a four stand continuous billet casting machine. Copper will be tapped from the arc furnace and carried by ladle to the holding furnace of each stand. These units will be capable of casting billets in the 3 to 5 in. diameter range.

Kennecott's well-known dedication to the cause of quality control is much in evidence at this new Refinery. A separate supervisor in charge of quality control, reports directly to the Refinery manager, Mr. Pickering.

A major part of the smooth operation at the new Refinery is the modern transportation of materials. As operations superintendent, Mr. A. H. Kunkel notes:—"You won't find any narrow gage railroad tracks in here, it's all fork-lift trucks, straddle trucks and cranes." The refinery floors are remarkably open. There is room for safe working, and metal follows the most efficient course through the Refinery.

The authors wish to express their thanks to Mr. Pickering and the other management personnel of the new refinery for their hospitality and cooperation during E&MJ's recent visit.

Appreciation is also expressed to the various executives of Kennecott's Western Mine's Division, Salt Lake City, of which Kennecott Refining Co. is a part.



MAINTENANCE on Lectra Haul's drive system has been greatly reduced—there are no axles, propellor shafts, or transmissions.

UNIT RIG said that by using its electric wheels for dynamic braking, the 55-ton capacity ore carrier can quickly go from full speed to a smooth, effortless stop. Doing away with the wearing parts of conventional brakes has greatly cut repairs.

New Electric Wheel Speeds Pit Haulage

A MOTORIZED electric wheeled ore carrier which has no transmission, axles, or gear shift and which is said to be capable of cutting open pit haulage costs by as much as 30%, was recently demonstrated by Unit Rig & Equipment Co., Tulsa.

The hauler's power is generated by a Cummins VT-12 turbodiesel engine and then distributed evenly to four General Electric motorized wheels (for a description and cut-away of the wheel itself, see E&MJ, June 1959, p 49).

As part of the demonstration, the company's 55-ton capacity truck, "Lectra Haul," was fully loaded and driven smoothly up a 6% grade at 8 mph—the driver at no time had to change speeds. At the end of the run, the dump body was lifted by two hydraulic rams and was emptied in 23 seconds. Lectra Haul's ability to run up grades as steep as 15% help it cut hauling time and reduce roadway maintenance.

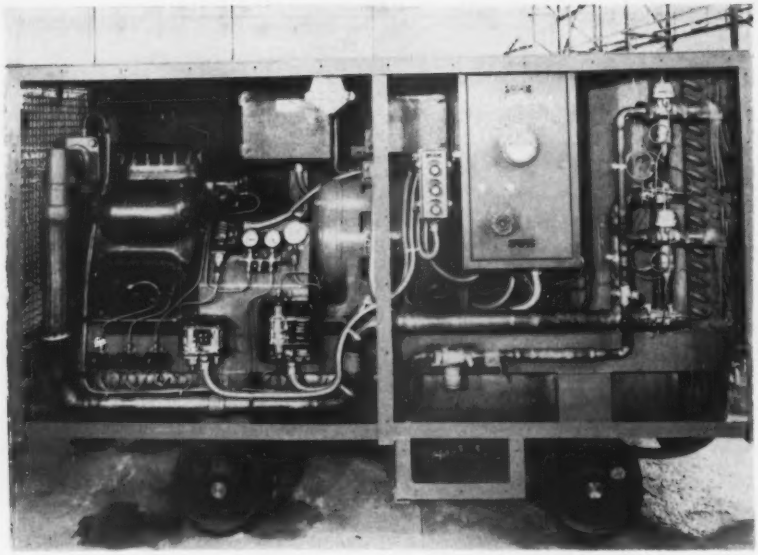
Two advantages given ore carriers by GE's wheel were clearly shown at the Lectra Haul demonstration: great maneuverability and rapid stopping.

After a 15 ton dump truck had traced out a pattern of figure eights, the Lectra Haul, though its hauling capacity was four times that of the smaller truck, followed the course with ease and accuracy.

Lectra Haul was then run at high speed and brought to a sudden, yet smooth, stop—showing the enormous holding power through the use of the electric motors for dynamic braking. For down grade operation, no friction brakes are ever needed — Unit Rig said that this will give the highest continuous braking without mechanical wear.

Steering wheel, foot throttle, brake pedal, and other Lectra Haul controls are all conventionally placed, so that there should be no need for extensive special driver training.

The firm claimed another feature of the truck was simplified access to all parts needing periodic checks.



THE SPOT COOLER is about 4 ft 4 in. x 5x8 ft, mounted on 12-in. dia trolley wheels, adjustable to 24-in. or 30-in. track. The unit cools air at 6,000 cfm.

Mobile Cooler Conditions Africa's Hot Gold Mines

A MOBILE, self-contained cooling plant for reducing ventilation air temperature is becoming popular in South Africa's deep gold mines. The track-mounted coolers have a 30-ton refrigeration capacity, capable of cooling 6,000 cfm of mine air. The units are trammed to the working sites, cooling only air that directly affects miners and eliminating the need for large and expensive surface and underground refrigerating systems during development.

The units, manufactured by Trane Co. of La Crosse, Wis., are reported to have been used successfully in Witwatersrand mines where virgin rock temperatures of 104° F were recorded at 7800 ft, increasing by about 1° F for every 150 ft of vertical descent below that level. It is further reported that the units cooled tramming men for several thousand feet back from the development face.

According to D. J. Nelson, manager of the air conditioning and refrigeration department of J. L. Clark & Co., Ltd., Johannesburg distributors, the "spot cooler," using settled water at 95° F, gives about 30 tons of refrigeration, equal to cooling 6,000 cfm of air at 85° F wet bulb to 73° F.

The best refrigerant has proven to be F-12 (difluorodichloromethane), which is odorless, non-toxic, non-inflammable and non-explosive. The motor uses about 30 amps when operating on 550 v, 50 cycle current. Built-in lighting is fitted for service inspection and to enable the maintenance engineer to work on the unit underground.

In a report by D. F. H. Grave in the January JOURNAL OF THE SOUTH AFRICAN SOCIETY OF MINE VENTILATION, one unit, consisting of a four-cylinder reciprocating compressor with a 30-hp motor, a water-cooled condenser and a 24x30-in., six-row, direct expansion coil of the extended surface type with aluminum fins, was installed in a South African mine.

The unit was to ventilate the 57 level, 8400 ft below datum or 7800 ft below the surface. The conditioner ran for three years until a new shaft was holed, making cooler air available.

Ventilation was first established to the 57 level with downcast air reaching the development incline via one vertical and two inclined shafts and some 2,000 ft of crosscut and reef drives.

The total underground distance traveled by the air was 13,000 ft. Air reached the sinking shaft bank at 91.0 to 93.2° F. Air at the forcing fan intake was even hotter, as most of it had to pass through the hoist chamber before reaching the fan. Rock temperatures on the 57 level were 104° F, increasing by about 1° F per 150 ft vertical below that elevation.

Comparative readings for the spot cooler—stopped, and after two days with the unit under normal operation—are as follows:

Observation point	Plant stopped (Range, °F)	Plant operating (Range, °F)
Cooling plant intake		
Temperature	93.5/98.0	93.6/98.0
Volume	7,300 cfm	7,000 cfm
Cooling plant delivery		
Temperature	93.8/98.0	83.5/83.5
Shaft bottom delivery		
Temperature	93.8/97.0	83.8/85.4
Shaft base		
Temperature	93.3/95.3	86.8/88.1
Kata reading	3.5	10.4
75 ft from base		
Temperature	93.9/94.5	88.0/89.5
Kata reading	3.0	6.2

Heat extracted from the air was transferred to water, which ran in an open drain against the downcast air to a sump at the tertiary shaft. About 2,200 gal of water per hr flowed along the drain, leaving the cooling plant at 105° F and reaching the sump at 93.2° F. Along the reef drive, the heating effect on the intake air was small—26,000 cfm reached the development shaft at 90.0° F with the cooling plant stopped and at 90.3° F with the plant running.

Terms Used in Cooling

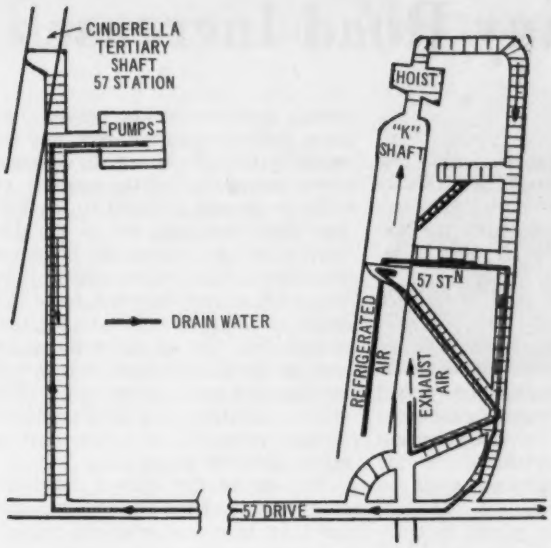
Btu—British thermal unit, the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

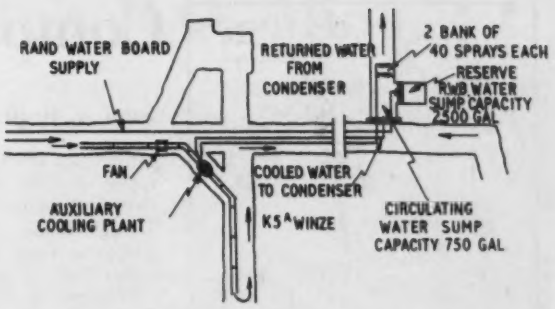
Kata thermometer — An instrument for determining the velocity of air currents in free spaces. The instrument is heated above 100° F and the time required in seconds for it to cool from 100 to 95° F, when located in the air current, gives a measure of air speed.

Refrigeration, ton of — Removal of heat at the rate of 200 Btu per minute or 288,000 Btu each 24 hours; equivalent to the amount of heat needed to melt one ton of ice in 24 hours.

Temperature, dry bulb—The temperature of a gas or mixture of gases as indicated by an accurate thermometer.

Temperature, wet bulb—The temperature indicated by a thermometer if the bulb is covered with a wet wick and air is passed over it.





ABOVE UNIT cools a winze at City Deep mine, South Africa. Condenser water is spray-cooled by upcast air in a raise. A 17,000 cfm air volume ranging to 92.5°F was available.

CONDITIONER on 57 level of South African mine (left) cools development incline via one vertical and two sloping shafts, 8400 ft below datum or 7800 ft below the surface.

From the reef drive to the cooling plant position, the heating effect was much greater; air quantity was less and the water was at its hottest. Air south of the cooling plant was 90.0° F wet bulb with the plant stopped and 94.2° wet bulb with the plant running. It was recommended that the condenser water be piped over that distance.

R. E. Campbell-Pitt notes that in planning to sink an exploratory winze on the eastern section of the City Deep mine from 41 to 45 levels, a total distance of 1198 ft, high rock temperatures were encountered. There was a through connection beyond the point where the winze was to be sunk, and a volume of 17,000 cfm was available at temperatures varying from 86.5 to 90° F during the winter months and 89.5 to 92.5° F during the summer months. With such high initial temperatures, it was evident that development would be limited without cooled air.

A spot cooler was purchased, the plant designed to extract 6,000 Btu per minute from 5,000 cfm of saturated air at 85° F and 32 in. of mercury, representing a cooling load of 30-tons refrigeration.

Consideration was next given to disposal of heat in the condenser water.

It was not practicable to gravitate or pump the condenser water to the main pumping circuit and so to surface, but it was possible to spray the water into the upcast air in a winze-raise connection between 39 and 41 levels, 350 ft east of the exploration winze.

Knowing the air on the delivery side of the condenser sprays would increase to about 96° F saturated, the possible heating of the intake air to two stopes about 3,000 ft from the sprays had to be considered. As a precaution, it was decided to course the air through to one stope, and stop work if necessary. However, that was not necessary, as at no time during the running of the plant was there any serious temperature increase in the stopes.

Condenser water was pumped from the plant to the raise where it was sprayed into the upcast air through two banks of 40 sprays each. The water, cooled by the upcast air, fell to the bottom of the winze where it was collected in a 750-gal sump and then through the condenser and back to the sprays.

On the side of the raise below the sprays, a reserve sump of 2,500 gal capacity was provided for the make-up water. Evaporation from the condenser water was about 45 gal per hour.

Rock temperature midway between the 41 and 45 levels was 108.2° F. The 41 level was located 7844 ft below the shaft collar and the 45 level was 8359 ft below shaft collar. Ventilation conditions at the winze face before the cooling plant started were 88.8 to 94.8° F for the winter with a wet Kata reading of 10.5 millicalories per sq cm per second and summer temperatures of 91.5 to 94.0° F with a wet Kata of 6.3 millicalories per sq cm per second.

The plant effected the results shown in the above table.

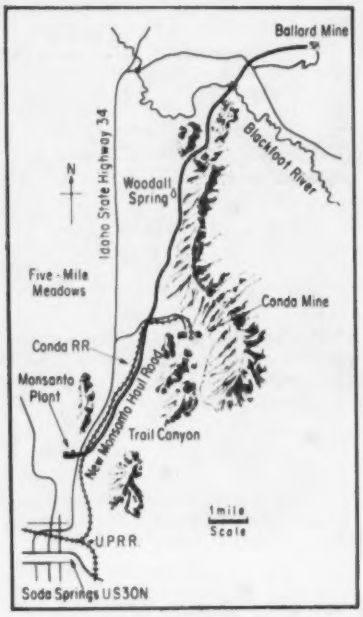
About 32.5 tons of refrigeration was extracted from the 7,600 cfm of air ventilating the winze. About 46 tons of refrigeration heat were rejected into the 15,000 cfm upcast current.

When the winze had reached a depth of about 980 ft, the face temperatures were 86.5 to 90.0° F with the cooling plant in operation. Later, when the plant was shut down for one day, the face temperatures were 92.0 to 93.0° F.

Table B Spot Cooling at City Deep, *Ltd.*

	No cooling	With cooling
Fan volume	7,600 cfm	7,600 cfm
Temperature intake	86.4/90.5° F	86.5/90.5° F
Cooler (evaporator)		
Intake		87.0/93.0° F
Outlet		76.0/77.0° F
Ventilation column		
Delivered volume	6,000 cfm	6,000 cfm
Delivered temperatures	88.0/94.8° F	79.0/85.0° F
Face temperatures	89.0/94.0° F	82.8/88.0° F
Wet Kata	10.9	16.4
Return air in winze		
Top of winze	88.8/94.5° F	85.5/93.0° F
100 ft below 41 level	89.0/95.2° F	85.3/93.2° F
200 ft below 41 level	89.0/95.8° F	85.0/92.8° F
300 ft below 41 level	89.0/96.0° F	84.5/92.0° F
400 ft below 41 level	89.0/95.0° F	83.3/89.0° F
50 ft north of delivery		
Temperatures	89.0/95.0° F	84.0/89.0° F
Wet Kata	7.3	12.4
Condenser water sprays		
Volume of air passing through sprays		15,000 cfm
Air temperature in		89.0/91.0° F
Air temperature out		95.0/95.0° F

Company Road Increases



SHORTER by 3.7 miles, Monsanto's road sharply reduced haulage costs and time.

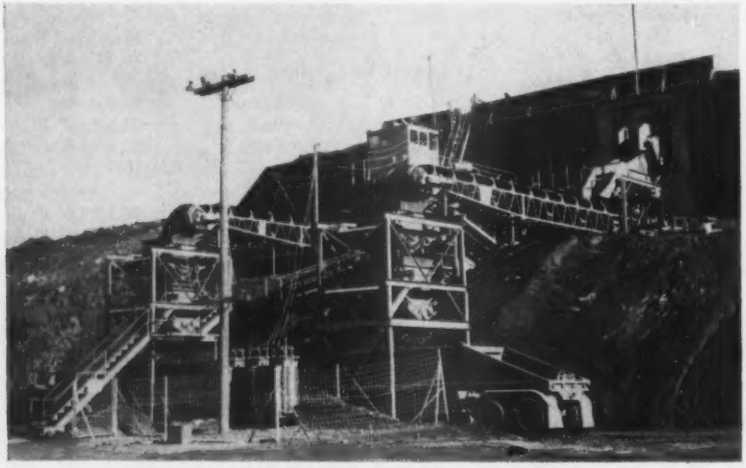
John B. Huttl

MONSANTO CHEMICAL CO.'S chief ore supply for its current two furnace elemental phosphorus plant at Soda Springs, Idaho, comes from the Ballard mine some 10½ air miles northeast of the plant. The property is held under Federal lease along with other mine holdings and originally was chosen to start production of phosphate rock because of its favorable location and shallow dip. Actual mining operations began in the summer of 1952, and the first elemental phosphorus was produced in the newly erected one-furnace plant on Dec. 1 of that year.

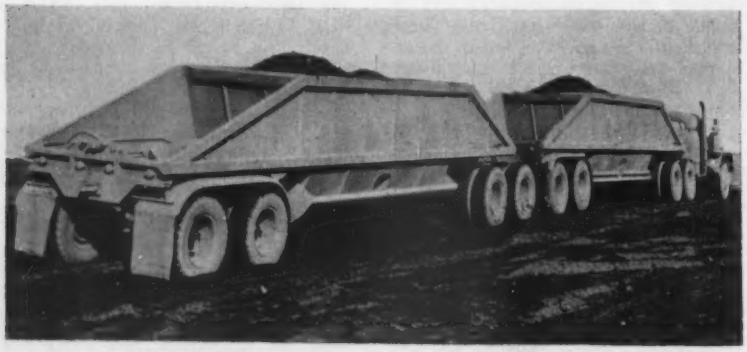
A second furnace, placed in operation in 1954, increased the plant capacity to 60,000 kw. This required an annual ore supply of some 500,000 tons. As the ore reserves at the Ballard mine originally were limited in extent, addition of the second furnace made it apparent new reserves would have to be found. Exploration work started during the summer of 1955 in an area adjacent to the Ballard mine workings, led to the discovery of a previously unknown Phosphoria shale outcrop with a strike length of several thousand feet. The angle of dip, however, was much steeper than that of the sedimentary beds at the Ballard mine. Subsequent development work carried out in this area and completed in 1956 disclosed a large potential ore reserve but a much higher stripping ratio.

This meant that only a relatively small portion of the available tonnage could be recovered with the mining and haulage methods then being used unless mining costs were decreased to defray the cost of additional stripping required. The unit cost of ore already had reached the economic limit. This difficulty called for introduction and use of a new mining method or a different haulage system that would provide a saving equal to the added stripping cost.

The Phosphoria shale section occurring at the Ballard mine is about 180 ft thick and contains two mineable ore units. Only the lower section is mined. The overlying waste material consists chiefly of siltstones and limestones. Exposed ore is mined by open pit methods. Overburden is stripped by Caterpillar D-9 tractors, some of which mount special 45-yd scrapers, and others dozer blades. The ore proper is selectively mined by a D-9 dozer pushing to a 1½-yd Northwest shovel, which, in turn, loads it into specially constructed aluminum trailers drawn by LH Mack trucks powered with 210-hp Buda engines. Prior to construction of the new haulage system the units hauled the ore to the furnace plant at Soda Springs over state, county, and private roads, a distance of 15.2 miles. A total of 15 of the units were then in operation. Each loaded unit grossed a maximum of 79,000 lb, the maximun allowed on the highway by the State of Idaho, which amounted to a payload of about 21 tons. The trucks operated 16 hours a day, six days a week during the June to October mining season. Daily tonnage moved averaged 4,200 tons.



HIGH SPEED LOADING FACILITIES include screening and automatic sampling equipment. Tandem 35-ton trailers require 3-min for loading and unloading.



BS-73 MACK TRACTORS, powered by 375-hp Cummins diesels pull the assembly at an average 45-mph, top, 65-mph. Surface is a 4-in. thick plant mix oil mat.

Costs Had to Be Cut

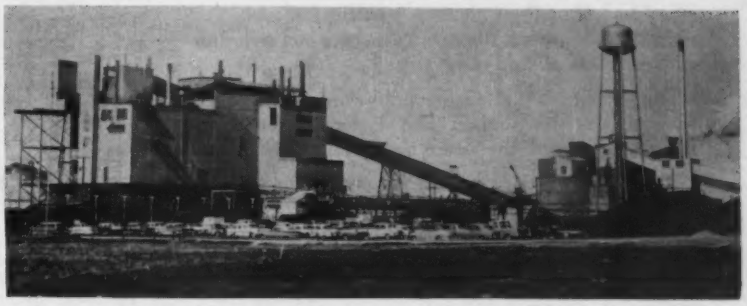
The comprehensive study started by the company in the fall of 1956 to determine which mining phase—min-

Reserves at Monsanto's P_2O_5 Mine

ing proper or haulage—would best provide the required savings pointed to a change in haulage method as the best means for attaining their objective. Accordingly, different methods of transportation were investigated—namely, (1) a railroad; (2) belt conveyor; and (3) a private haul road. The private haul road was selected, as it offered the greatest savings by reducing the haul length by 3.7 miles. Not only would the per ton-mile cost be considerably reduced by the road approach, but it would require the smallest capital investment.

Decision to build such a road was made in the spring of 1957, and negotiations to obtain by purchase, or option, the 100 ft width needed for the right of way from many local land owners were started immediately. It was not until December 1958 that the company obtained 100% control of the right of way. Three preliminary location surveys were made in the fall of 1957 to determine the best and shortest route. Principal factors considered in the location of the road were: (1) shortest possible route; (2) least amount of adverse grade; (3) lowest cost of construction; (4) a physically strong roadbed to support the extra heavy haulage equipment to be used; and (5) the right-of-way to be of least inconvenience to the local land owners. The company entered into a haulage agreement with Morrison-Knudsen Co., part of which involved construction of the road. M-K has contracted the mining, stripping and hauling at the Ballard mine for the past 7 years, with Monsanto furnishing the layout and control plus complete supervision of mining operations. The detailed design of the new road was furnished by the M-K engineers. Construction of the road was started in September 1958 and continued until late December, during which period about 65% of the road was completed.

The new road, as built, is 11½ miles long and follows the course shown in Fig. 1. It crosses State High-Highway 34 near the furnace plant and the paved country road leading to Conda. The road passes over hilly ground used for cattle grazing, flat-lying cultivated ground used for dry farming, and uneven waste land. In the sections traversing grazing areas, there were placed three cattle underpasses made from 120-in diameter multi-plate pipe. In the cultivated areas, suitable equipment crossings were provvided, including one 20x20-ft underpass to permit farmers to move large farming units from one side of the road to the other without having to cross it. Crossing of the Blackfoot River was effected by erection of an 80-ft steel span supported bridge. The two road crossings mentioned have a semaphore light system at the intersections designed to comply with state Highway Engineer's recommendation that the light should normally show green to public traffic. A pressure pad installed on the company road 500 ft from the intersection actuates the signal to turn red to highway traffic. The system is so timed that the ore truck must slow down to 15 mph at the intersection to cross without stopping. This crossing arrangement affords the public the most safety by having the highway blocked the least amount of time. The road is fenced on each side for its entire length. During the mining season a roving guard sees to it that all public traffic is kept off the haulage way. The road has a maximum of 2.7% adverse grade.



UNITS UNLOAD while in motion at furnace plant. A 23-mile round trip takes 45-min. 5600 tons are hauled by 4 units in two shifts. A fifth unit is spare.

Road Stands Up Well

The 4-in. thick and 26-ft wide plant mix oil mat, laid on a 16-in. base course, has stood up well. Localized failures, due to freeze and thaw, have been minor and few. Haulage equipment now used and owned by M-K consists of five trucks with two bottom-dump trailers in tandem on each unit. The trailers are drawn by No. BS 73 Mack tractors equipped with 375-hp Cummins engines. The trailers have a truck capacity of 35 tons each, or a total of 70 tons per assembly. Total length of each unit is 94 ft 7 in. Maximum operating speed is 65 mph. In general, the trucks operate at 45 mph. Four units are in operation at a time, the fifth serving as a spare.

Under the present haulage schedule each truck makes 10 round trips per 8-hour shift, involving a travel distance of 23 miles. Time required for each trip is 45 min, which includes 3 min required to load the truck at the mine and unload it at the stockpile area at the head of the furnace plant. Daily production amounts to 5,600 tons, when operating 16 hr a day. Under the old transportation system the time required for each truck to make one round trip was 1 hour 7 min. Average daily production was 4,200 tons. The new trucks have required no other maintenance work other than routine inspection and oil and grease jobs. The tires also are giving satisfactory service.

The new truck loading station constructed and maintained near the entrance to the Ballard pit area consists of a twin storage, sizing, and loading installation. Ore stockpiled near by is pushed by a D-9 dozer into two 25-ton capacity storage bins. From here it is fed over two vibrating grizzlies, spaced 3 in., with the oversize going to the waste dump and the undersize, via 42-in. belt conveyors, to 9-ton weigh bins under which each truck-trailer unit is spotted for loading. Equipment for sampling the grizzly undersize consists of two gate samplers, belt conveyor, jaw crusher, automatic splitter to reduce 200 lb samples to 6¼ lb, and sample storage. Final samples are composited every 4 hours. At the furnace plant stockpile, the trucks unload their ore cargo while passing slowly over the dump area.

The new haulage system has been in operation for practically one full mining season. Results obtained in the matter of moving tonnage, time saved, and lower costs have fully justified the capital investment made by Monsanto. The savings made are applied to make ore reserves available for processing which otherwise would probably never be recovered.

MR. BOND TELLS HOW rod-mill efficiency, as measured by work index, reduction ratio and power draft, is seriously affected by broken rods in the charge, and can be further reduced by the use of rods too small for the size and hardness of the ore particles.

Calculations based on the operation of a wet overflow rod mill in open circuit show that:

1) The 4-in. rods fed to the mill wore down to an equilibrium size distribution and began to break at 2¼-in. dia. At 1½-in. they were nearly all broken.

2) The weight of the broken rods present in the mill was 4% of the total rod charge.

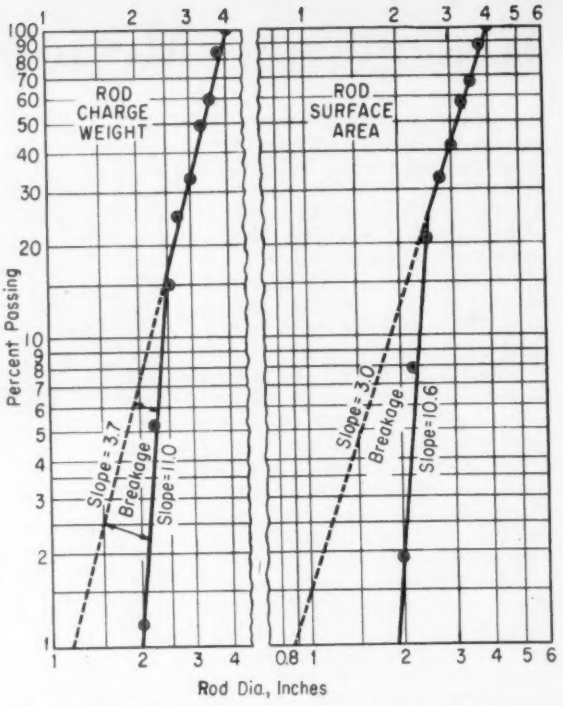
3) Broken rods reduced power draft and mill capacity, increased product size and work index, and swelled the rod charge.

4) These results are accounted for by assuming that each broken rod eliminated one full length rod from grinding and added one empty rod space to the grinding charge.

5) Feed particles too hard for the rods to grind efficiently act to further swell the rod charge and to increase the work index. A new formula for proper rod size is derived.

6) Values for frequency and vertical component of rod fall can be computed.

7) One large particle per foot of rod length is broken by each rod fall, on the average.



CHANGE IN SLOPE of solid line is point at which character of charge changed and where rod breakage began.

Action in a Rod Mill

FRED C. BOND

THE OPERATION within a grinding mill is primarily a mathematical process. Some of the factors are still not determined, but a detailed study of the available data can yield a surprising amount of information.

Operating factors in a grinding mill include the following: feed size, reduction ratio or product size, feed hardness or work index, natural size distribution of material, presence of soft, lubricating, clayey or water absorbent material, specific gravity of material, percent moisture, mill diameter, mill speed, mill lining and lifters, mill length, discharge level and size distribution, grinding media shape and surface area, grinding media specific gravity, roughness of grinding media surfaces, etc. We can find our way through this maze of factors only by experience, and this experience can be formulated to some extent.

It is fortunate that grinding mills are heavy, rugged machines which are not too sensitive in their response to some of the factors listed above. However, the satisfactory operating conditions in rod mills have a smaller range and are more interdependent and critical than in ball or pebble mills because of the extended breaking action of each rod.

Generalizations, theories, and formulas regarding grinding mill behavior result from collected experience and study. They are extremely useful, but like all human endeavors they are subject to error, and require constant checking. This is particularly true when a mill exhibits some apparent anomaly in its operation. Detailed analysis in such a case can indicate the importance of factors which have hitherto been neglected.

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A Plant Scale Test

This wet open-circuit overflow rod mill was 10 ft in dia inside the lining and 16 ft long inside the lining with an internal volume of 1,260 cu ft. It was driven by an 800-hp motor at 14.74 rpm, or 61% of its critical speed, and drew about 655 hp. The shell was armored with conventional single-wave cast lining with the top of the lifter waves about 2.5 in. above the valleys. Make-up steel rods, 4 in. in dia and 15.5 ft long, weighing 660 lb, were added three times a week to replenish the rod charge. Broken rods were not regularly removed from the mill, but were allowed to discharge with the ore. The rod consumption was 1.03 lb per ton ground. It had been operated for several years in this manner, and the rod charge had reached complete equilibrium. From Eq. (2) in the appendix it should have occupied 40% of the mill cross-sectional area. [2] At 390 lb per cu ft it should weigh 95 tons, and from Eq. (3) it should draw 807 hp. [2]

The mill ground 175 short tons per hour at 80% solids of hard ore with a specific gravity of 3.40, from 80% passing 15,440 microns, or ⅝ in., to 80% passing 3700 microns, or about 5 mesh. The reduction ratio was only 4.18/1. From Eq. (1) in the appendix, at 655-hp input the work index was 33.3 which was about twice the work index value indicated by laboratory rod-mill grindability tests on this ore. The high work index and the low power drawn by this mill did not agree with the formulas and required an explanation.

Rod Size Distribution

The mill was operated five days without receiving any make-up rods. During this time the rod charge was

depleted by eight tons below its average equilibrium value. Then the mill was ground out, shut down, and photographed with the discharge end removed. Measurements on the photograph showed, from Eq. (2), that the rod charge occupied about 31% of the mill cross sectional area. However, the rod charge actually weighed 63 tons equivalent to only 25.5% of the mill area at 390 lb per cu ft.

This 63 tons included four tons of broken rods and rods which had worn extremely flat—78 pieces in all. These were culled from the charge. It was estimated that there were 2.5 tons of broken rods alone in 60 pieces, constituting 4% of the weight of the total rod charge.

After culling, the rod charge weighed 59 tons and consisted of 339 full-length rods with a total length of approximately one mile, and an average weight of 347 lb each. The rods were sorted into groups with average diameter differences of ¼ in. The number of rods in each group was recorded. These are listed in the table. The weight of each group was calculated from the statement that one foot of rod weighs 2.67 B^2 lb, where B is the average diameter in inches. The total calculated weight checked the measured weight of 59 tons. The surface area of each group was calculated from the statement that one foot of rod has a surface area of 37.8 B sq in.

The rod weight distribution and rod surface area distribution from the table are plotted on log-log paper in the graph shown. The percent cumulative weight passing each rod size plots as a straight line with a slope of 3.7/1 through the 2.5-in. rod size. Starting with 2.25-in. dia rods, the plotted size distribution line becomes much steeper with a slope of 11.0/1. It is evident that rod breakage begins at 2.25 in. dia and increases regularly for the smaller rods, with only one 1.5-in. rod unbroken.

The rod surface area distribution plots as a similar straight line with a slope of 3.0/1, with a similar break at 2.25 in. dia rods.

Equilibrium Rod Size Distribution

(Four-In. Rods Fed)

(1) Av. Dia In. B	(2) Number of Rods	(3) Total lb	(4) % Cum. Weight	(5) Total Sq. In.	(6) % Cum. Surface Area
4.00	0	0	0	0	0
3.75	32	18,600	15.78	70,400	12.50
3.50	58	29,400	40.72	119,000	33.72
3.25	27	11,800	50.72	50,300	42.67
3.00	52	19,350	67.13	91,500	58.92
2.75	30	9,400	75.10	48,400	67.52
2.50	45	11,650	85.00	66,000	79.24
2.25	55	11,500	94.76	72.600	92.14
2.00	29	4,810	98.84	34,000	98.17
1.75	10	1,270	99.92	10,250	99.99
1.50	1	93	100.00	780	100.00
Total	339	17,873	100.00	563,230	100.00

Broken Rods Spoil Efficiency

The broken rods present decrease the grinding efficiency and decrease the power drawn by the mill by increasing the apparent volume of grinding charge. Rod mill grinding is accomplished principally by the impacting line contact of the falling rods. With normal lifters there is little or no rolling or sliding of the rod charge on the rising side of the mill. Each broken rod in the mill will prevent the full line contact of another rod falling upon it, and even the partial line contacts will average less than the length of the broken rods because they often do not lie parallel to the full length rods. In these cases the line contact of several falling rods will be decreased when they strike the nonparallel broken rod.

We will assume here that the effective line contact of each parallel broken rod will be neutralized by the contact losses caused by nonparallel broken rods. Then the 60 broken rod pieces in the mill will cancel out the grinding of 60 of the 339 full length rods. The number of effective rods remaining is 339 — 60, or 279. Thus, the broken rods have directly decreased the effective grinding of the rod charge by 17.7%.

The broken rods also decrease grinding capacity by swelling the rod charge. The exact amount is indeterminate because some of the broken rods do not lie parallel to the long rods, and here again we will assume that each piece of broken rod is equivalent to an unoccupied rod space in the grinding charge. This means that our 339 rods would occupy the volume of 339 plus 60, or 399 rods. The volume is increased 17.7%, and one cubic foot of rod charge will weigh 390x339/399, or 332 lb. The broken rods thus increased the computed cross sectional area of the grinding charge from 26.5% to 31.2% of the mill inside cross section, in agreement with the measurements made on the photograph.

On this basis when the eight tons of rods ground out before shutdown are replaced, the total rod charge cross sectional area becomes 35.2% of the inside mill area.

Since the rod area actually measured about 40% of the mill area, the remaining 4.8% must result from the swelling of the rod charge caused by pieces of hard ore between the rods. Soft ore would probably swell the rod charge less than this.

Eq. (3) in the appendix applies to a compact charge of unbroken rods weighing 390 lb per cu ft. Our rod charge as swelled by broken rods and hard ore particles weighs only 71 tons per 488 cu ft, or 291 lb per cu ft.

The void space in a compact rod charge is 20% of the volume of grinding charge. The volume was increased 17.7% by broken rods. The additional ore swelled 4.8/40, or 12% of the grinding charge volume. The broken ore thus occupied about 50% of the volume of the 488 cu ft of the grinding charge, or 244 cu ft. The packed broken ore weighed 128 lb per cu ft. However, it can be assumed that in the moving grinding charge it will only weight one-half of its packed weight, or 64-lb per cu ft. Thus the broken ore in the grinding charge weighed eight tons and required 2.75 min to traverse the rod charge. The total weight of the rods and ore in the mill grinding charge was 79 tons, or 324 lb per cu ft.

The calculated power drawn by the rod mill with a compacted 40% grinding charge weighing 390 lb per cu ft was 807 hp. The actual power with the swelled 40% charge should equal approximately 807x324/390, or 670 hp. This agrees fairly well with the observed 655 hp drawn.

The observed low power input is reasonably accounted for by the contained broken rods and hard ore particles. However, the very high work index has not been explained. This will be attempted below:

Broken Rods; Hard, Coarse Feed Raise Index

The calculated plant rod-mill work index was 33.3 which was about twice that obtained in an Allis-Chalmers laboratory rod-mill grindability test on this ore. All metal contacts which do not cause ore breakage represent wasted energy input and increased

work index. The unproductive metal-to-metal contacts caused by broken rods directly increased the work index by 17.7% from 27.4. However, the broken rods probably were responsible for an additional portion of the increase in the work index as explained below.

A principal feature of this grind is the extremely coarse rod-mill product size, with 80% passing 3700 microns, or about 5 mesh, a feed with 80% passing 15,440 microns, or ⅝ in., and a reduction ratio of only 4.18/1. It is known that the reduction ratio is an important factor in the efficiency of rod mill grinding. The usual reduction ratio is about 16:1, and it has been observed that when the reduction ratio is above 20 or below 12, the work index can be expected to increase. Plant experience on this ore has shown that when the feed size decreased, the rod mill product size was markedly less, the reduction ratio was increased, and the work index was smaller.

It is evident that many coarse particles were discharging from the mill because of swelling of the rod charge. Broken rods allow open channels in the grinding charge through which oversize particles can escape from the mill. In addition, they allow large particles in the grinding charge to approach the discharge end of the mill and push the rods apart so that many rod line impacts are not sufficient to break the row of particles contacted.

Opening up of the rod charge has still another detrimental effect. It allows the feed particles to penetrate more rapidly through the upper rods in the charge, causing these rods to waste energy and to increase breakage in barren metal to metal contacts with the mill lining and with each other.

These effects are cumulative, and in the particular case being considered they apparently were sufficient to waste almost half of the energy input to the mill. This wasted energy is divided between barren metal-to-metal contacts and metal-to-ore contacts whose force is not sufficient to break the row of ore particles contacted.

It appears from this analysis that a rod-mill feed of hard tough ore should be crushed finer than that of a soft ore, and that broken rods in the charge may be more detrimental to the grinding efficiency of hard ore than of soft ore.

How to Calculate Rod Size

Equation (4) in the appendix was derived empirically for the proper size B of make-up balls in inches.[3] It was adapted for rod mills by substituting the constant 300 for 200 in the ball-mill equation. The theoretical values of the factors for ball mill grinding were considered in a subsequent article.[4]

In the particular rod mill being considered with the laboratory work index of 33.3/2, the value of B from Eq. (4) was 3.82 in., so that 4-in. dia rods were fed. However, experience on this very hard ore has shown that the large ore particles are not broken efficiently, indicating that Eq. (4) for rod mills should be revised. Eq. (5) is derived below:

In rod milling under constant conditions the number of particles theoretically contacted by a single rod remains constant, so that the contacting force on each particle varies as B^2 instead of as B^3 in ball mills. Since the force required to break each particle varies as $F^{3/2}$ according to the Third Theory, [1] where F represents the particle feed diameter; then at a constant height of fall the work input varies as B^2 and $F^{3/2}$, so that B varies as $F^{3/4}$.

The work input varies as the work index Wi by definition, and in rod mills it varies as B^2, thus B varies as the square root of the work index.

Since in rod mills the work input is proportional to the percentage Cs of the critical mill speed, and it is proportional to B^2, then B varies as $1/\sqrt{Cs}$.

Since the force varies as B^2, and at constant Wi and F values the work required per particle varies as the specific gravity S, it follows that B varies as $\sqrt{S}$.

Since the weight of the rod charge increases as the mill diameter squared, or D^2, and the linear shell velocity at constant Cs increases as $\sqrt{D}$; it follows that the work input theoretically varies as $D^{5/2}$. The number of rods of any size B varies as D^2, so that the work input per rod varies as $\sqrt{D}$, or as the linear speed of the mill. Since the work input per rod on each particle varies as B^2 it follows that the rod diameter B is proportional to $1/D^{1/4}$.

The calculation of proper rod diameter B should contain an additional factor Thr which represents the short tons of ore fed per hour per ton of rods, and is proportional to the number of particles of size F contacted on each foot of each average rod fall. The rod size B varies as Thr.

When these relationships are combined we have:

$$B \frac{F^1}{250} \sqrt{\frac{Thr \times Wi \times S}{Cs\sqrt{D}}}$$

Eq. (5) is satisfactory when $Thr \times Wi/S$ is less than 10, and/or when the reduction ratio Rr is greater than 10. When $Thr \times Wi/S$ is larger than about 10 the feed rate is too high for efficient breakage; some of the particles contacted on each rod fall are not broken, and the reduction ratio decreases below 10. Then the plant work index increases above the laboratory tested Wi value used in Eq. (5).

Rod Action: A New Concept

One of the most difficult and necessary parts of any analysis of the happenings within a grinding mill is a determination of the average motion of the grinding media. So many indeterminate factors are involved, such as slippage of the grinding charge, that no completely satisfactory description of the grinding media motion has ever been made. In this paper a new concept is applied to the problem which seems to give reasonable, if incomplete results.

A body in free vertical oscillation falls from its highest position under the influence of gravity, and is stopped forcibly by an equal deceleration;[2] it is then accelerated upward at the same rate by the application of an outside force, and reaches the same highest position as before, falls, and completes the cycle of movement. It describes a simple harmonic motion over a vertical distance of h in. with c cycles per minute, where

$$\sqrt{h} = 295/c \qquad (6)$$

The critical frequency of vibrating bodies is calculated from this Eq. (6) in the appendix. As the c (or rpm) decreases through the critical value, the tendency to maintain free vertical oscillation causes the amplitude h to increase, and causes vibrating screens to "jump" as they pass through the critical speed in stopping.

The power necessary to maintain free vertical oscillation is directly proportional to the period of oscillation (1/c) and to $\sqrt{h}$. Where K represents the power in kilowatts necessary to maintain a ton mass in free vertical oscillation, then

$$K = 328/c = 1.115\sqrt{h} \qquad (7)$$

The vertical component of the motion of a particle of no diameter against the lining of a grinding mill at critical speed corresponds to free vertical oscillation with $h = 12D$ and c = rpm. However, it has been observed that the average rod in a grinding charge makes about three cycles of movement during one revolution of the mill.

Neglecting friction losses and the elevation of ore and water, each ton of rods actually draws:

$\frac{655/1.34}{59+4+8}$ = 6.88 kw, and from Eq. (7)

$h = (6.88/1.115)^2 = 38.2$ in. Also

$c = 328/6.88$ = 47.7 cycles per min

$47.7/14.74$ = 3.23 cycles per mill revolution;

in other words, the power input is sufficient to elevate the average rod in the mill charge 38.2 in., 3.23 times per mill revolution.

The vertical component of the actual average rod motion is undoubtedly more complicated than the simple harmonic motion of free vertical oscillation. However, this method furnishes values for the average height and frequency of fall which appear probable and can be used in calculations of energy transfer.

Transferring Energy to Ore

The energy input required for grinding was 2.79 kwh per ton. When multiplied by the constant 3.97 this is equivalent to 11.1 joules, or watt-seconds, per gram. The total surface area of the full length rods is 563,230 $\times$ 67/59 sq in., or 4.13-million sq cm. Thus, one square centimeter of rod surface represents an average weight of 14.7 grams and a power input of 0.118 watts.

However, most of the breakage in a rod mill results from line impact, and the work done is better evaluated per unit of rod length. The total rod length including the broken rods is $339 \times 15.5 \times 71/59 = 6330$ ft or 193,000 cm. Thus, one centimeter of rod length represents an average weight of 333 grams and a power input of 2.53 watts. Each fall from an average height of 38.2 in. (3.18 ft) represents 0.323 kg-meters or 3.17 joules per cm of rod length. The rod length required to grind one gram of ore in one fall is $11.1/3.17 = 3.50$ cm. Each average rod fall represents $347 \times 3.17 = 1105$ ft-lb, or 1500 joules.

The rod mill ground 175 tph, or 97.1 lb per sec. This was equivalent to 395 lb per mill revolution or 122 lb per average rod fall cycle. There were $339 \times 71/59 = 408$ rods in the grinding charge, including broken rods, so that each rod should grind in each fall 0.299 lb, or 135 grams of ore. This required $11.1 \times 135 = 1500$ joules.

When the feed with 80% passing 15,440 microns was plotted according to the Third Theory [3] it had a slope *Er* of 0.244 and a crack length of 4.85 cm per cc. The product with 80% passing 3700 microns had an *Er* value of 0.456 and a crack length of 12.7 cm per cc. The new crack length produced was 7.85 cm per cc and $11.1 \times 3.40/7.85 = 4.80$ joules per cm. With the laboratory-test work index of approximately 33.3/2 only 2.40 joules would be required to produce a centimeter of new crack length.

These figures can be used to estimate the number of large particles contacted by each average rod fall. The average rod fall should have sufficient energy to break a number of particles of the size *F* which 80% of the feed passes. The particles are assumed to be cubical in these calculations. One size *F* particle, 15,440 microns dia breaks to form the equivalent of $(15{,}440/3700)^3 = 72.5$ product particles of size *P*. It has a crack length of the square root of one-half the surface area, or $\sqrt{(1.544)^2 \times 6/2} = 2.68$ cm. The product has a crack length of $72.5\sqrt{(0.3700)^2 \times 6/2} = 46.5$, so that breakage of one *F* particle forms 43.82 centimeters of new crack length, and requires $2.40 \times 43.82 = 105$ joules of energy input. One average rod fall releases 1500 joules, and should break $1500/105 = 14.3$ size *F* pieces, or less than one size *F* piece per foot of rod length. However, with the actual plant rod-mill work index of 33.3, it can only break 14.3/2, or 7.15 size *F* particles.

One size *F* particle weighs 12.51 grams, and each rod fall grinds 135 grams, equivalent in weight to 10.8 size *F* particles. If it is assumed that the kinetic energy of the average rod fall with a reduction ratio of only 4.18/1 is mostly consumed in breaking large particles, it can be estimated that about 10 particles of average size *F* are contacted in each average rod fall, and that about 6.5 of these are broken. However, if the feed size were crushed finer to $F = 12{,}550$ microns, then one size *F* particle could weigh only 6.72 grams. The 135 grams broken by each average rod fall would be equivalent to 20.1 size *F* particles, and nearly all of the large particles contacted would be broken, reducing the plant work index to about 33.3/2.

These estimates are necessarily inexact, but they supply a more detailed picture of the action in a rod mill than was hitherto available. They show that the number of large particles broken by each rod fall is much smaller than had been supposed.

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(3) "Comminution Exposure Constant by the Third Theory," MINING ENGINEERING, Dec., 1957.

(4) "Grinding Ball Size Selection," MINING ENGINEERING, May, 1958.

Appendix

Symbols

- F = Size in microns 80% of feed passes.
- P = Size in microns 80% of product passes.
- W = Kilowatt hours motor output per short ton ground.
- Wi = Work Index.
- Vp = Percent of internal mill cross sectional area occupied by grinding charge.
- D = Inside mill diameter in feet.
- Q = Vertical distance in feet from inside top of mill to levelled grinding charge.
- Cs = Percent of critical speed = $1.305 \times \text{RPM} \times \sqrt{D}$
- Kwr = Kilowatts per ton of grinding rods.
- h = Inches of free vertical oscillation.
- c = Cycles per minute of free vertical oscillation.
- K = Kilowatts to maintain a ton in free vertical oscillation.
- B = Rod diameter in inches.
- S = Specific gravity of ore.
- Thr = Tons per hour per ton of rods.

EQUATIONS

$$Wi = W \Big/ \left(\frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right) \quad (1)$$

$$Vp = 113 - 126\, Q/D \quad (2)$$

$$Kwr = D^{0.4}\,(6.3 - 5.4\, Vp)\, Cs/100 \quad (3)$$

$$B = \sqrt{\frac{F\,Wi}{300\,Cs}\sqrt{\frac{S}{\sqrt{D}}}} \quad (4)$$

$$B = \frac{F^{\frac{1}{2}}}{250}\sqrt{\frac{Wi \times S \times Thr}{Cs\sqrt{D}}} \quad (5)$$

$$\sqrt{h} = 295/c \quad (6)$$

$$K = 328/c = 1.115\sqrt{h} \quad (7)$$

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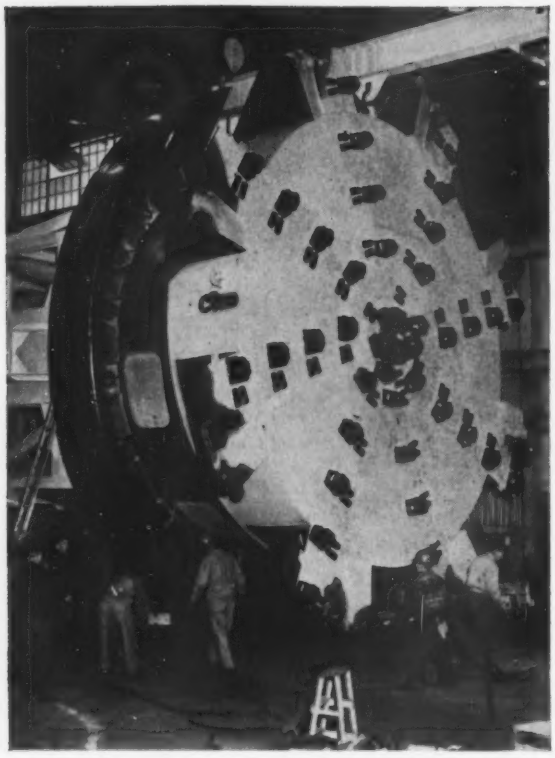
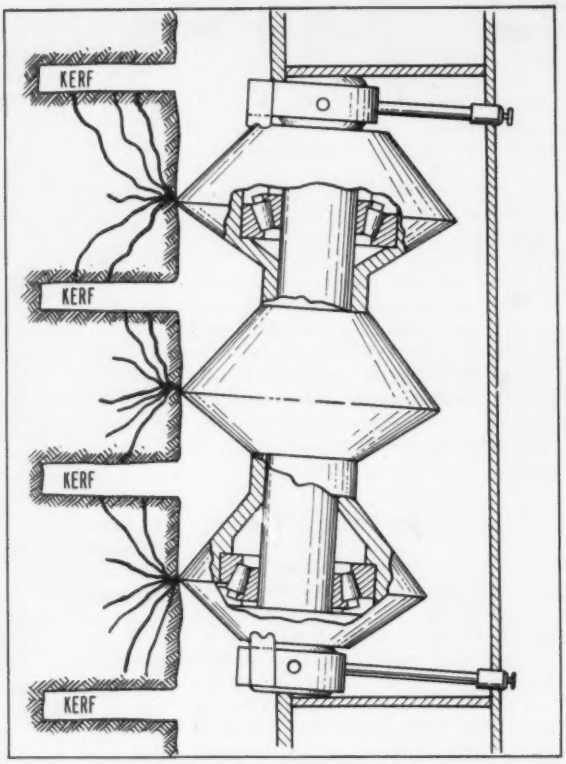


THE THIRD MOLE supplied to the Oahe Dam project, this 29.5-ft dia borer is a greatly improved version of the first.



FIXED CUTTERS, rolling disks on a rotating head produced the effect shown. Idea is now modified for hard rock.

Tunnel Boring Through Harder Rocks

SEVERAL YEARS AGO, when the first Robbins Mechanical Mole was able to bore a 29.5-ft dia tunnel in shale at about 10 ft per hr, it was seen that here was a tunneling method potentially competitive with present day cyclic operations in which advances of 60 to 90 ft per day might be expected under favorable conditions.

The continuous borer, designed and manufactured by James S. Robbins & Associates, Inc. of Seattle, won its fame on the Oahe Dam diversion tunnels at Pierre, S. D. Since that time, the Robbins people have been accumulating experience on a variety of rocks, but their background is as yet limited to the operations of seven machines (see tables). It appears that the Mole will be suited for a wider range of rock types than at first thought possible.

The two latest machines, Nos. 131 and 351, are representative of two of Robbins' most advanced designs. Their performances are summarized in table II.

Basically, the present day Mole consists of a large rotary cutting face which mounts rolling disks and, in some units, fixed, drag-type cutters, all arranged to cause spalling of rock from the working face.

In back of the cutting head are hydraulically actuated gripping shoes and propulsion cylinders which not only provide torque reaction but keep the required cutting pressure against the tunnel face. The large diameter soft rock machines propel forward by pushing on the ring beam reinforcing.

Rock crumbling from the face as the result of pressure and torque applied to the cutting head is scooped up by rotating buckets fixed to the rotating head periphery just behind the cutters. When the buckets become inverted at the top, the rock falls onto a conveying system which passes it back to the rear of the machine. In the case of model 351 the rock is handled by three conveyors before being dropped onto the main conveyor for removal from the tunnel.

Some of the more important advantages of the continuous boring method are:

1. Safety. Round, smooth, unshattered openings are inherently strong. Rockfall danger is slight, and usually little or no support is necessary.

2. Overbreak. If a tunnel is to be concreted, the saving in not having to fill the usual amount of overbreak from blasting can be large.

3. Lower labor cost. A much smaller crew is needed to bore a tunnel than to drill and blast one.

4. Rapid tunnel advance. While average advance rates (advance per total elapsed time) in rocks bored thus far are still in line with good records by conventional methods in igneous rocks, some boring speeds (actual cutting rates) of from 8 to 12 ft per hour have been attained in sedimentary rocks. (Comparison is difficult because conventional methods used in certain soft rocks, for example, might result in a low advance rate against a potentially high boring speed.)

5. Improved haulage. The uniform size of broken rock from a borer makes muck disposal easier. Under some circumstances, belt conveyors can be used instead of track haulage.

6. Blasting damage. Boring eliminates damage to property in congested

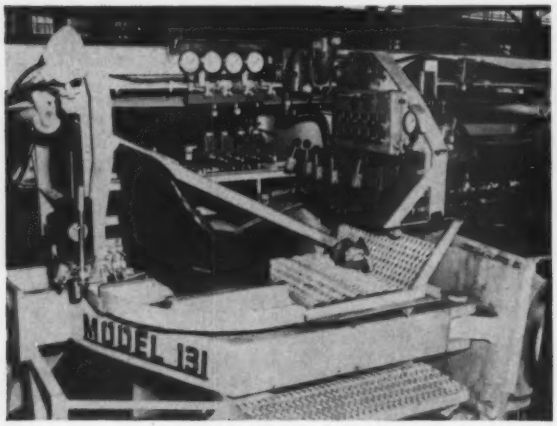
Table I — Machine Performance and Characteristics

Unit No.	1	2	3	4	5	6	7
Model No.	**910**	**930**	**101**	**102**	**103**	**131**	**351**
Contractor	Mittry Constn. Co. Los Angeles California	Oahe Constructors St. Paul, Minn.	Perini & Sons Framingham, Mass.	Dravo Corp. Pittsburgh	(1) S. A. Healy Co. & (2) Steep Rock Iron Mines	Foundation Co. of Ontario Toronto, Can.	Morrison-Knudsen-Kiewit-Johnson
Job on which used	Oahe Dam—Upstream Diversion Tunnels Pierre, S. D.	Oahe Dam—Downstream Diversion Tunnels Pierre, S. D.	Pittsburgh Sewer Tunnels	Pittsburgh Sewer Tunnels	Chicago Sewers & Steep Rock Iron Mines, Ontario	Toronto Sewer Tunnels	Oahe Dam—Upstream Power Tunnels
Bore Dia	25 ft 9 in.	25 ft 9 in.	8 ft	8 ft 6 in.	9 ft	10 ft 9 in.	29 ft 6 in.
Total HP	450	450	400	400	400	400	800
Rotation HP	400	400	310	310	310	340	680
Forward thrust	180,000 lb	192,500 lb	117,600 lb	117,600 lb	117,600 lb	314,000 lb	250,000 lb
Torque, ft-lb	281,000*	360,000*	138,000	107,000	138,000	176,000	684,000
RPM—no load cutterhead	Inner—9.2 Outer—6.3	Inner—6.6 Outer—5.24	8.2	10.6	8.2	10.6	4.5
Average hourly advance rate while cutting	8 ft-12 ft/hr	8 ft-12 ft/hr	6 ft-8 ft/hr	8 ft-10 ft/hr	2 ft-4 ft/hr in limestone 10- to 12 ft/hr in iron ore	8 ft/hr	8 ft-12 ft/hr
Best advance rate while boring	61 ft/8 hrs						54.5 ft/8 hrs
Average advance rate per shift	20 ft-40 ft/shift					24 ft-35 ft/shift	25 ft-35 ft/shift
% Operating time	30-51%					30-50%	Approximately
Cutters (1) and/or Disks (2)	1 & 2	1 & 2	1 & 2	1 & 2	1 & 2	2	1 & 2
Single Rotation (1) or counter rot. (2)	2	2	1	1	1	1	1
Length of tunnels						14,800 ft	7,680 ft
Rock types	Soft shale	Soft shale	Shale	Shale & Limestone	(1) Hd. Chicago limestone 18-24 K PSI Comp. strength & (2) Iron ore	Hd. xline limestone sandstone & shale	Soft shale
Condition of ground	Faulted, squeezing	Faulted, squeezing	Tough shale	Interbedded shale & limestone	(1) Very uniform in Chicago (2) Very squeezy & fractured in iron ore.	Hardness of strata varied from K PSI 8-27 Comp. Str.	Very bad roof Bentonite mud in faults.
What Water flow?	None	None	Very wet	Wet	Dry	Dry & very wet	None
Steel sets & supports, while boring	8 in. WF 31 ring beams on centers	8 in. WF 31 ring beam on 2-4 ft centers	None	None	In iron ore yielding sets	Liner plate roof bolted to top ¼ of tunl.	8 in. WF 31 ring beams on 2-4 ft centers
Concrete	Yes	Yes	Yes	Yes	Yes & No	Yes	Yes
Belt or train haul	Belt	Belt	Train	Train	Train	Train	Belt
Men req. for opera. & main. machine	5	5	3	3	3	3	4
Men for sets	12				2	2	10–15
Total men	29		10	10	8	10	Approximately
Weight of machine	125 tons	130 tons	17 tons	17 tons	17 tons	65 tons	175 tons
Comments	Low operating time due to bad ground, supply & conveyor problems	Same problems in performance as Model 910	Excessive breakage of fixed tools bits incr'd downtime & cost/ft	Same probs. as Model 101	Chic. limestone too hd. for this mach. but bored successfully in Steep Rock iron ore.	Quota basis of 24 ft/shift, bal. of time for main. & roof support. All disk cutters, no fixed tool bits used.	Avge. rate of adv. 3 ft/hr of shift time on 880 ft tunnel (13 dys). Muck removed by conveyors to skip hoists up 145 ft shaft.

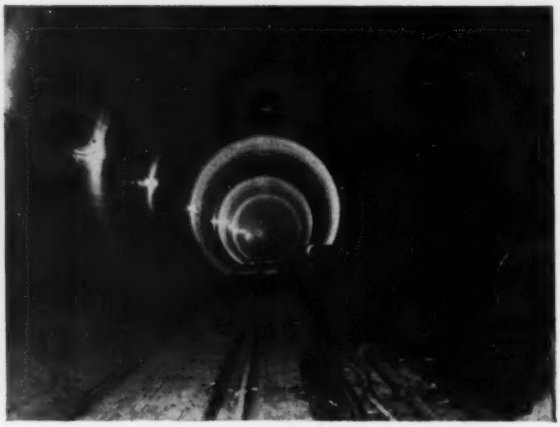
*Capable of 100% overload at stall.

NO. 131'S CUTTING HEAD produced this pattern. It was the first machine to be designed without fixed cutters.

AFTER COMPLETING one of several tunnels, No. 910 has had its buckets removed and is being pulled back to shaft.



ALL OPERATING CONTROLS—electrical and hydraulic—are arranged for easy, safe operation from this cockpit.



THE SAME TUNNEL (29½-ft dia) shown with finished concrete lining. Floor, track and pipe will be removed later.

Table II — Performance Data

Model No.	131	351
Bore dia.	10 ft 9 in.	29 ft 6 in.
Total hp	400	800
Average hourly advance rate while cutting	8 ft/hr	8–12 ft/hr
Best advance rate while boring	?	54.5 ft/shift
Average advance rate	24–35 ft/shift	25–35 ft/shift
% Operating time	30–50%	Approximately
Length of tunnels	14,800 ft	7 tunnels—average 1,100 ft
Haulage—belt or train	Train	Belt
Rock types & condition of ground.	Hard crystalline limestone, sandstone and shale. Hardness of strata varied from 8–29 kpsi comp. str.	Soft shale. Very bad roof conditions. Bentonite mud in faults.
Steel sets & supports while boring	Liner plate roof-bolted to top ¼ of tunnel.	8 in. WF 31 ring beams on 2–4 in. centers.
Comments	All disk cutters, no fixed tool bits used.	Rate of advance averaged 3 ft/hr of shift time on 800 ft of tunnel (13 days).
	Quota basis of 24 ft/shift for tunneling crew. Balance of time for maintenance & roof support.	Muck removal by conveyors to skip hoists up 145 ft shaft.

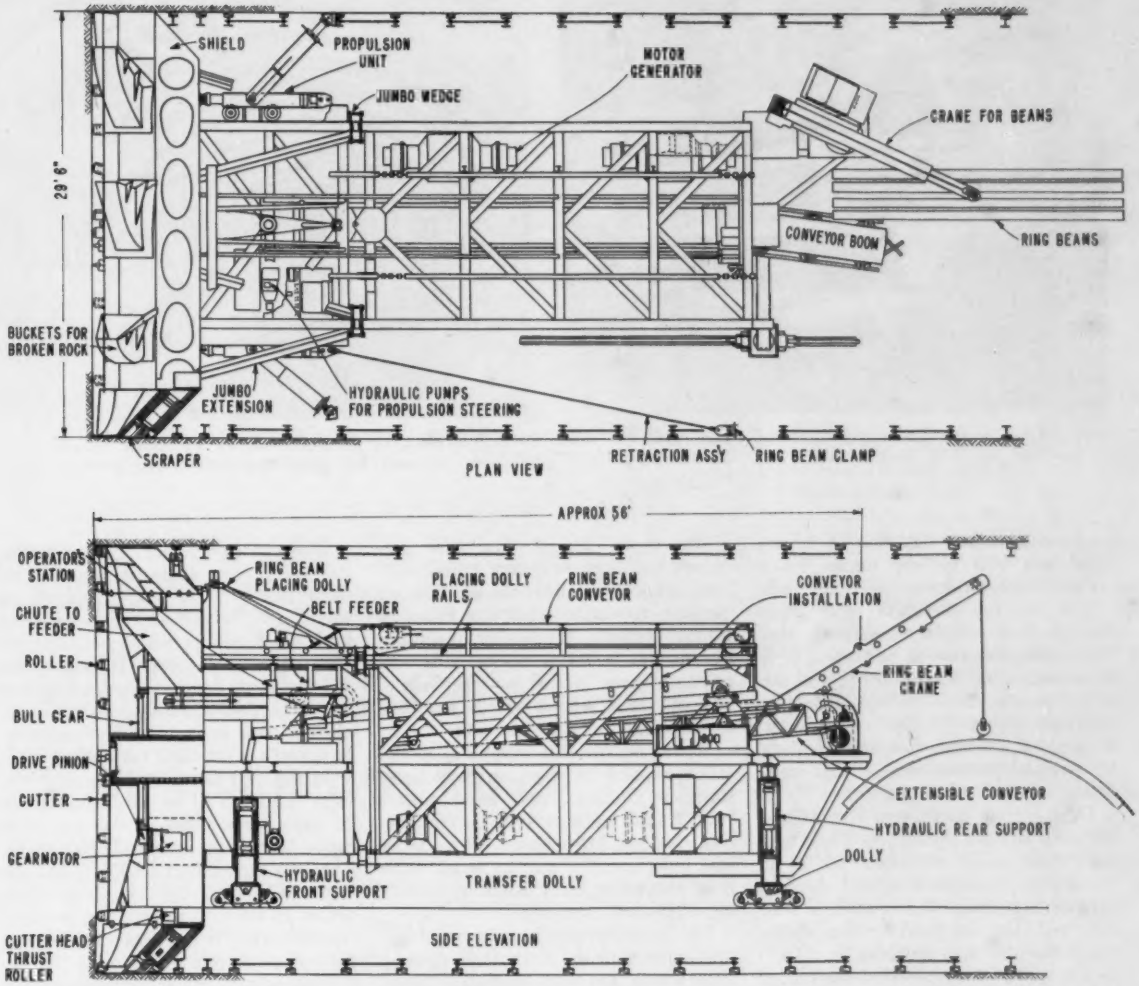
areas and/or to the roof and walls in bad ground.

Some present disadvantages of the system are:

1. Limitation as to types of rock that can be bored. Five out of eight jobs tackled by Robbins have been in shales of varying hardness. In Toronto the Mole (No. 131) was successful in an extensive project in hard, crystaline limestone, sandstone and shale, advancing at speeds comparable to those of the much larger Moles in the soft Pierre shale. But in Chicago a borer had proved unable to advance at a practical speed in a hard limestone. (A change in cutter design, based on the Chicago experience, made the Toronto success possible.)

The Mole can surely cope with all soft rocks, regardless of origin. It is believed that time will show many of the harder sedimentaries and metamorphic rocks, as well as certain igneous rocks, to be amenable to the method.

2. High capital cost. To date, these



THE ROBBINS BORER, in its successive models, incorporates various designs which have been proved in other jobs. Earlier models required fastening to the side wall for stability—newer and larger models are held by their own weight.

machines have been built for special jobs and are fully amortized at completion. Robbins is considering the idea of having rental machines available to make their use more financially attractive.

3. Curved tunnel bottom. This has some disadvantages. Robbins is giving thought to a Mole design which will produce tunnels with oval and horseshoe-shaped cross-sections.

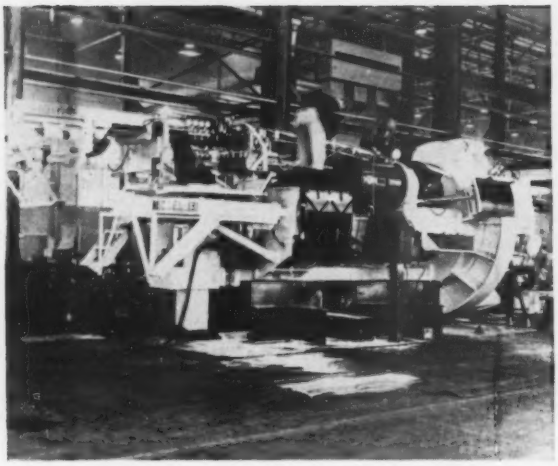
The history of the mechanical continuous miner goes back to the McKinlay entry driver of the 1870's which was successful in boring its way one mile through chalk under the English Channel toward France before the project had to be abandoned. Had tungsten carbide been available then, the venture might have been a success.

Many years later, James S. Robbins saw an old McKinlay borer and conceived the idea which turned into the Goodman Miner, a well known machine of today. It was when the Miner was applied to driving slopes through rock which would usually require blasting that the idea of the disk cutter was developed. It was found that rock, being harder and less brittle than coal, could be fractured by rolling a sharp-edged disk on the rock surface between kerfs cut by fixed cutters (see drawing). At the rolling contact of the disk on the rock, the point pressure created spalls the rock outward toward the kerfs. It was found that use of the disk cutters reduced the power requirements and feed pressures, increased the penetration rate, and produced good chip size.

A machine based on this concept was used to drive a tunnel through the soft shales under the Arkansas river.

The Robbins Mechanical Mole was conceived when the Mittry Construction Co. of Los Angeles contracted with the Corps of Engineers to drive 25-ft 9-in. dia tunnels on the Oahe Dam Project at Pierre, S.D. Mittry saw that the Pierre shale and Crow Creek marl were proper applications for a tunnel borer, and James S. Robbins & Associates were awarded a contract to design and build a machine for the job. The result of this arrangement was a borer weighing 125 tons at a design cost of $85,000. It was built in eight months in 10 machine shops under a license agreement with Goodman Mfg. Co., who have the patent rights.

The Oahe Dam Project was complicated. Roof conditions were bad and the army had imposed stringent safety regulations. Rolled H-section rings had to be placed for ground support. This meant that ring placement had to be mechanized to keep



THE STAR of the Toronto project for Foundation Co. was machine No. 131, which bored 115 ft on its best day.

THE NATURE of the cut made by the borer usually eliminates roof support, but when necessary, it can be done easily.

pace with tunnel advance. And not only was part of the tunnel on a curve, but alignment tolerance was ±1-in. in any direction, and grade had to be precisely maintained. Humidity was required to be kept at 95% to prevent rock deterioration, and the tunnel had to be lined with 2.5 ft of concrete within 30 days of opening. It worked out that tunneling had to be stopped periodically so that concreting could be brought up.

Despite the handicaps, the Mittry crew did an outstanding job. Their best eight hour shift produced 61 ft of bored and re-inforced tunnel. In one engineering study the operation was observed for six consecutive shifts when the average progress was 40.5 ft per shift. But the total operating time was only 51% of total time. The downtime was taken by having to reset the propelling jacks, difficulty in supplying material to the machine, cave-ins of the roof and face ahead of the rings, and an overloaded conveyor system.

No disk cutters were replaced, but 362 fixed cutter bits were consumed in six consecutive shifts. Seven men are chargeable to the operation of the machine for maintenance and supervision. In addition, 15 men were needed to place and weld the ring beams and to gunnite. The entire crew inside the tunnel, and a supporting crew outside for service and muck haulage, was 29 men. In a 6-day week the crew drove 635 ft—an adequate haulage system and better roof support might have doubled the rate. While operating, the advance rate varied from 8.5 to 12 ft per hr.

To date, Robbins has built seven tunnel boring machines. With growing confidence, harder rocks are being tackled. And time has brought evolution in design. The first machines had a two-element cutterhead. The inner and outer heads rotated counter to each other to effect a torque balance. In smaller machines the torque is taken up by side-wall gripping shoes, and in the large model 351 the dead weight of the machine is sufficient for the reaction.

It was on the fifth machine, model 103, designed for work in hard limestone at Chicago, that fixed cutters were found to be unsuitable for cutting harder formations. This Mole was subsequently put to work with good success at Steep Rock in squeezing fractured iron ore.

The breakthrough in cutter tool design came with the sixth Mole (model 131) which has just finished a large sewer-boring job for the Foundation Co. of Ontario. At Chicago, the carbide inserts were hard enough to cut, but the drag-type tool bits suffered from excessive shock loading and the inserts could not be kept in the tools. Replacement of tool bits was a major source of downtime and expense. Now, on the Toronto machine, the disk cutters are arranged to eliminate the fixed cutters except for a small number in the central part of the cutterhead. This change has been made without loss of boring speed, and the high cost of bit replacement has been eliminated.

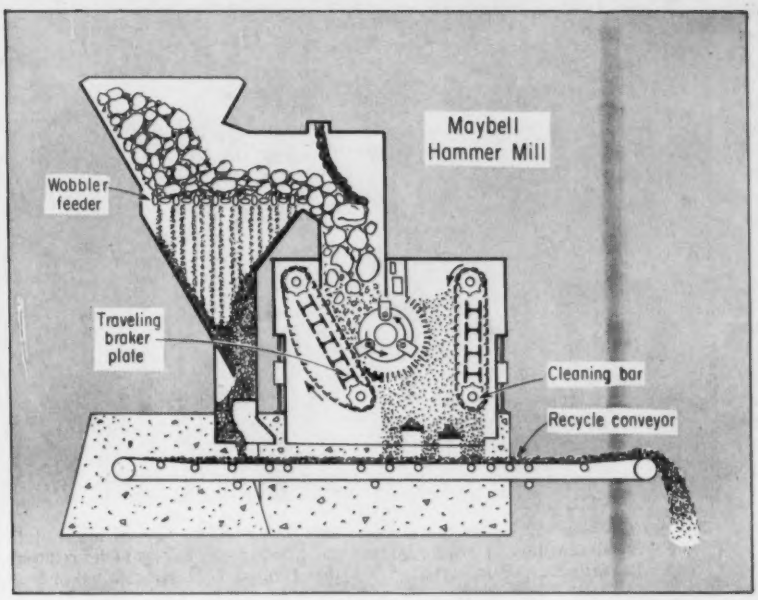
The seventh Mole, Model 351, was built for Morrison-Knudsen-Kiewit-Johnson and was the third big one to be delivered to the Oahe Dam Project. It differs from the two earlier ones there in several ways. The machine is capable of placing the ring beam supports closer to the tunneling face; it has lateral and vertical adjustment which keeps the machine on grade and permits tighter turns.

Even though Model 351 is boring the soft Pierre shale, it is using the hard-rock type of cutter, shown on model 131, in conjunction with drag-type fixed cutters which are suitable for use in soft rock. However, the fixed cutters are mounted in such a way that they act only as scrapers to clear a path in front of the disk cutters, and are not used for cutting rock.

Model 351 completed the first 880 ft of the sixth of its seven tunnels in 13 days, on a 3-shift, 7-day per week basis, averaging about 3 ft per hr. The best day it bored 135 ft, and the best shift bored 54.5 ft. It requires about 10 days to retract the machine through the bored and re-inforced tunnel, dismantle it, raise it to the surface in two major sections and 11 smaller pieces, lower it into the next 145-ft deep shaft, reassemble it and begin boring the next tunnel.

Costs with the Robbins Mole are based primarily on expense of labor, power and machine write-off. A machine for a 12-ft dia tunnel might cost $200,000. A 5,000-ft tunnel driven with this machine at an average speed of 5-ft per hour would cost about $11.50 per cu yd, or $28-ft. This includes the cost of a five-man crew, but not the cost of haulage, roof-support labor and equipment. The figures indicate that a boring machine could be justified on even relatively short tunneling jobs. In addition to savings on excavation costs, a bored tunnel of 12-ft dia will save an average of one cu yd of concrete per ft of tunnel length, depending on the condition of the rock.

The Air Force Ballistic Missile Division has shown interest in a proposed Robbins shaft sinker which could continuously bore shafts from 10 to 45 ft in diameter.



MAYBELL HAMMER MILL has rotating elliptical bars set alternately in a row to screen undersize at feed. Moving breaker plate and bar eliminate clogging.

Maybell Mill Crushes Wet Uranium Ore

TALL CENTER BUILDING is crushing plant and smaller building is transfer point. Main feed belt is in galleyway at left while pyramid on right stores fine ore.

CRUSHING URANIUM ore containing 20% slimes and a high percentage of clay in conventional crushing equipment ran up high crushing costs for the Maybell, Colo. uranium mill of Trace Elements Co., a subsidiary of Union Carbide Co. Costs were cut by converting to a special hammer mill with a traveling breaker plate and cleaning bar.

The Maybell ore is so friable that crushing the oversize is no problem, but because of its high moisture content it tends to stick to everything it touches. For that reason it was virtually impossible to handle ore in the double impact breaker which the company moved from its old plant in Rifle, Colo. for the original Maybell setup.

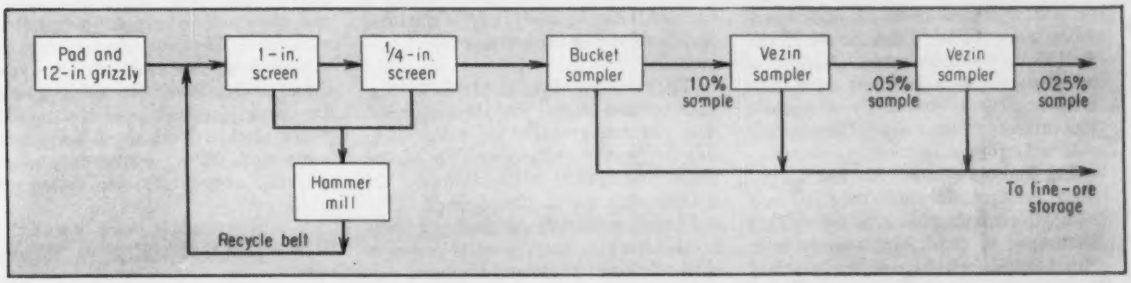
The two sets of hammers in the original crusher rotated in opposition. With normal feed, the unit seldom operated for more than 30 minutes without the material packing itself tightly in the mill. The machine then had to be shut down and cleaned out with an air spade.

Engineers of Union Carbide Nuclear Co., which administers Trace Elements from its Grand Junction operations office, tried several schemes to little avail in an attempt to move ore through the unit. First they added 25% hard rock to the raw ore feed to clean the crusher. When that didn't work they reversed one rotor to operate both hammers in the same direction, hung two chain curtains from the top of the unit and added a moving cleaning bar. With that setup, it was possible to get nearly an hour of continuous operation before the crusher choked itself.

They then installed a chute to reject oversize during periods when the crusher was down, but the interruption in ore handling was undesirable.

The problem was finally solved by replacing the impactor with a moving-breaker-plate hammer mill. The new crusher handles more than 75 tph without shutdowns due to material buildup.

Ore for the Maybell uranium proc-



FLOWSHEET shows continuous recycle of the oversized and sampling of throughs.

essing mill is friable, poorly-consolidated sandstone. The material includes much bentonite clay and is always wet.

Trucks and scrapers transport the ore from the mine. It is weighed and stockpiled at the pad. A dozer or a front end loader works the pad, dumping ore on a 12-in. grizzly and into a 30-ton below-grade hopper. Beneath the hopper a 10-ft x 54-in. apron feeder delivers the ore to a 350-ft x 42-in. inclined belt conveyor.

The tail pulley of the raw ore feeder-conveyor is located 18 ft below grade. Traveling 100 fpm, the feeder carries ore up a 15° slope and discharges it 71 ft above the floor of the crushing building. Like all of the plant's outdoor conveyors, the belt is housed in a galleyway of corrugated aluminum sheet.

Raw ore is crushed, screened and prepared for processing in the 35x42-x78-ft prefabricated steel building. Ore from the feeder-conveyor is screened, overflow going to the crusher and fine underflow directly to fine-ore storage. Screened overflow is discharged into the moving breaker-plate hammer mill.

About 50% of the material is oversize and must be crushed. After crushing it is returned to the raw-ore conveyor and thence to the screens. In order to assure non-clogging operation the sizing plate and grate bars have been removed from the hammer mill to completely open up the discharge end of the unit.

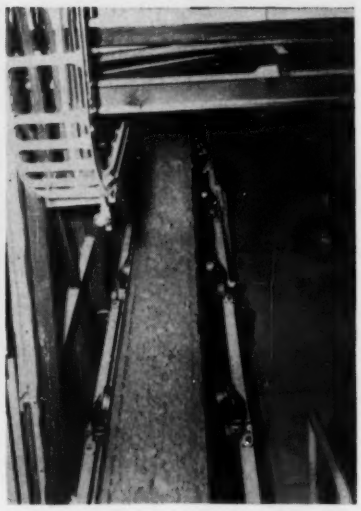
Moving Plate Cleans Mill

The hammer mill's operation is assisted by a traveling breaker plate and moving cleaning bar. The unit is a Bulldog H-03 manufactured by Hammermills, Inc., Cedar Rapids, Iowa, a subsidiary of Pettibone-Mulliken Corp. Its breaker plate moves, as do the swinging hammers, in the direction of feed. The breaker plate constantly feeds material through the crusher, preventing buildup. The moving cleaning bar travels counter to the hammers, preventing thrown material from sticking to the end wall of the breaking chamber.

The Maybell hammer mill is equipped with 18 27-lb hammers, arranged in three rows of six, which swing on a 24-in. dia hammer circle. A 125-hp electric motor drives the hammers through a V-belt drive. The breaker plate is driven by a separate 7½-hp motor and the cleaning bar with a 5-hp unit.

Crushed material is discharged from the hammer mill to a 10-ft x 30-in. horizontal conveyor belt which discharges to the 18-in. recycle belt. The recycle belt carries the crushed material back to the raw-ore belt, discharging it to a transfer point located in a small tower.

ORE LOADER works high grade stockpile above 30-ton hopper with apron feeder delivering to 75 tph crusher.



RECYCLE BELT carries material back to main feed belt which returns to the 1-in. and ¼-in. screens and mill.

Fine ore being carried to stockpile from the crushing plant is continuously sampled to determine its uranium content. Underflow from the vibrating screens drops to a 25-ft x 30-in. horizontal conveyor which discharges into a chute above the fine-ore storage belt.

A schematic diagram of the entire ore-handling and crushing circuit is shown on the previous page.

In addition to the tractor operator working the pad, only one operator per shift is necessary for ore handling. He supervises the operation of the crushing and screening plant.

Conveyors, screens and sampling equipment are driven by electric motors through V-belt drives and the entire electrical system for the equipment is interlocked at a graphic control panel. In case of overload or trouble, all equipment, except the hammer mill itself, is shut down automatically. The hammer mill is purposely omitted from the interlock system to prevent shutting it down under load. In addition, all conveyors are traced with wire connected to a manual kick-out switch. Once the switch is opened it can be reset only at the head pulley of the conveyor to protect personnel.

The crushing plant at Maybell operates on two shifts, five days a week. The pits are operated on a one-shift, five-day week while operation of the processing plant is continuous, 24 hours a day, seven days a week.

During operation the crushing plant must be shut down several times a shift to clean chutes and hoppers. Actual operating time of the crushing plant is about nine hours per day at maximum capacity.

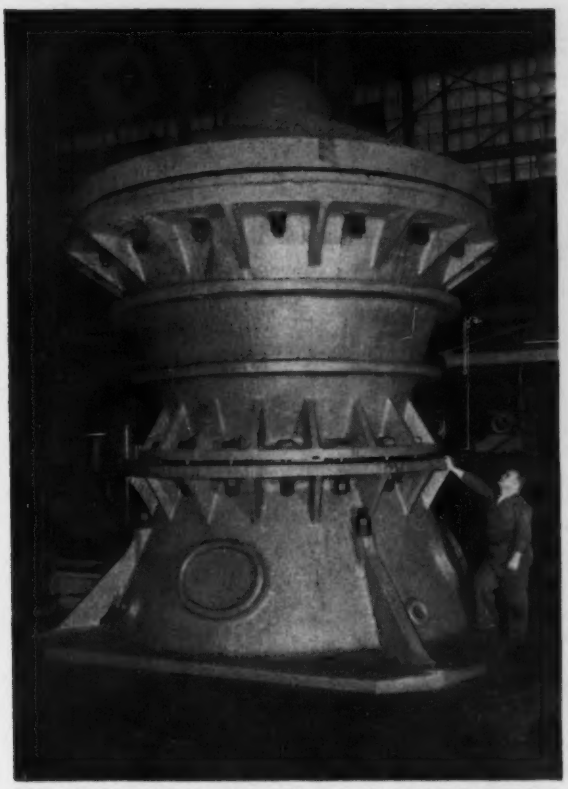
From the crushing plant ore is transported by a 300-ft x 30-in. feeder conveyor to the storage bin, a cone-shaped steel structure. Low grade and high grade ores are stored separately. Now ready to be processed, the ore is fed by apron feeders to two belt conveyors which carry it to the mill. An 18-in. belt transports high grade ore and a 30-in. belt carries the low grade feed.

Because of the stickiness of the ore, spillage from the apron feeders in the storage bin created a problem. Since it is almost impossible to clean it up as fast as it accumulates, the feeders are run at the slowest speed that can maintain feed rates. Cable scrapers have been installed at the discharge of each feeder. The feeders are also buffed and treated with silicone so that the sticky ore will break loose at discharge.

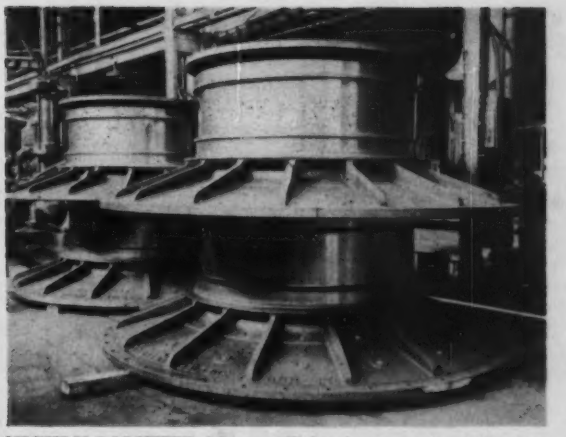
Initially the high and low grade ores are treated separately. The low grade is mixed with water and repulped. Then sand and slimes are separated and the slimes are acid leached.

High grade ore is first acid leached and then washed in counter current classifiers. The resulting slimes and values join the leached low grade slimes and both are treated in a counter current resin-in-pulp circuit. The pregnant eluat from the R-I-P process is precipitated in ammonia and the resulting concentrate is filtered and dried.

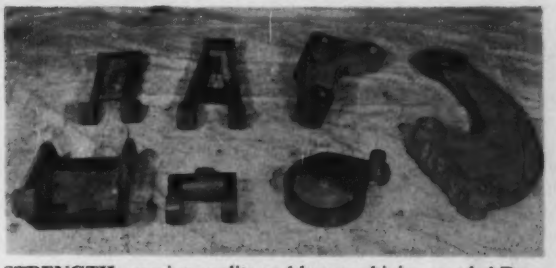
A similar unit is being installed at UCN's new Gas Hill, Wyo. uranium mill.



HIGH DAMPING capacity, resilience and machinability qualify Meehanite for use in crushers such as this Kennedy-Van Saun.



HIGHLY POLISHED Marcy mill heads are made of Meehanite because of its uniformity and anti-galling properties.



STRENGTH, wearing quality and low machining cost led Dorr-Oliver to Meehanite for these rake classifier linkage parts.

Heavy Duty Irons In Process Equipment

FREDERICK G. BENZ

COST REDUCTION and improved performance in mining machinery are frequently available through the use of iron castings.

A noteworthy material for this purpose is "Meehanite" metal. Meehanite is unique in that it offers to the design engineer a choice of properties with which to meet design requirements. In contrast to other common construction materials, Meehanite has the combination of high yield strength, machinability and uniform hardness regardless of section thickness. These qualities are obtained through precise control of the design, preparation and operation of the cupola as well as by careful selection of the materials charged into the melting unit. Meehanite depends for its success on control techniques rather than a specified chemistry to produce the required properties.

Mr. Benz is director, sales promotion and engineering service, Meehanite Metal Corp.

The general engineering type of Meehanite discussed here is used widely in jaw, gyratory and cone crushers; rod and ball mills, filters, classifiers and driers. Other Meehanite types are designed for resistance to abrasion, corrosion and heat.

The engineer must know how metal properties change with casting dimensions. If a foundry does not control its metal according to the changes in section, sharp reductions in physical property values may result. Fig. 1 illustrates how the tensile strength of ordinary gray iron falls off as the same metal is poured into heavier cast sections. Meehanite, properly adjusted for design and section thickness, maintains a more uniform tensile strength with only gradual reduction in values.

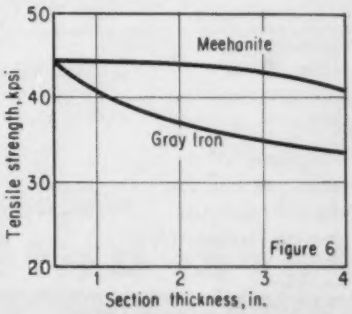


Fig. 1: Meehanite's strength holds well regardless of section thickness.

The hardness of a casting is similarly influenced by the mass of the cast section. To illustrate (Fig. 2 & 3) Brinell readings were taken across the faces of 6-in. and 12-in. blocks of gray iron and Meehanite. The gray iron blocks give a sharp drop in readings in the middle owing to lack of control. The Meehanite process, on the other hand, produced uniform hardness values.

Where cast iron sections are less than 1-in. thick another set of problems appears. As the cast section is reduced an inverse change in hardness and tensile strength occurs (Fig. 4 & 5). This condition can present serious problems in a casting, especially where machinability is important.

Meehanite's versatility is indicated by the curves.

Table I shows the properties available in several of the engineering Meehanites as well as in a typical cupola gray iron and a typical medium carbon cast steel.

The tensile strength of a metal is not necessarily its most important quality. When selecting a metal for construction the relative range of elasticity and plasticity are of vital importance.

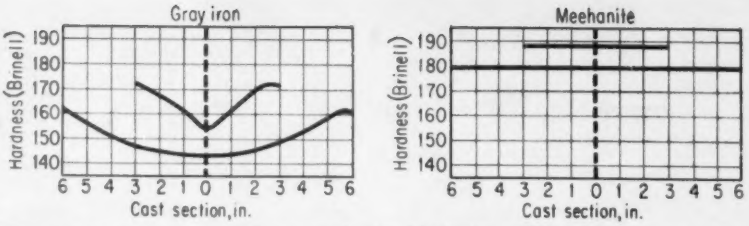


Fig. 2 & 3: Careful production controls give Meehanite uniform hardness regardless of section thickness. This gives the design engineer wide latitude.

Elasticity is Critical

The most important quality for most engineering uses is a metal's elasticity—or the stress that a metal will stand without permanent deformation. Permanent deformation occurs almost entirely within the "plastic" range of the metal or alloy.

The stress-strain diagram (Fig. 6) shows the elastic ranges of Meehanite and steel as a sraight line from O to A in each case. Point A is the point at which permanent deformation begins. It is the end of the elastic range and the beginning of the plastic range. This transition is measured as "yield strength" in iron and "yield point" in steel. The terms have nearly the same meaning.

In the case of cast steel, an intermediate range, A-B, usually exists where elongation (strain) of the metal occurs without corresponding increase of load (stress). Hence, in steel the plastic range includes A-B, B-C. In Meehanite the intermediate range does not develop and the plastic range A-C is of much smaller extent than in steel. Value of "C" is the total tensile stress developed by each metal.

In steel, when stress has reached the yield point, failure has begun and the considerable stress absorbed in passing from A to B has little useful structural value and can be misleading. Meehanite shows relatively little distortion between A and C. But in either case the design should be kept within the elastic limit of the material to be used.

From Table I it can be seen that the modulus of elasticity (which is a measure of stiffness) of medium carbon cast steel is much higher than that of Meehanite. But the elastic range (yield strength) of Meehanite is much higher than that of steel in an "as cast" condition.

Also, in the same cast steel the yield point is about 45 to 55% of its tensile strength whereas in GA Meehanite it is about 80% of the tensile strength.

Heat treatment of Meehanite and cast steel serves to raise the elastic limit about proportionately in both cases.

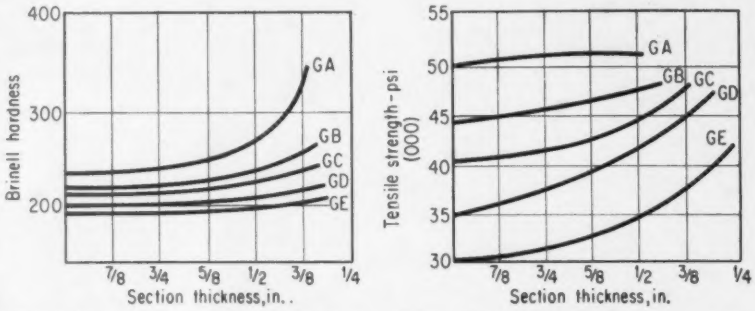


Fig. 4 & 5: Thin section brittleness, a problem with gray iron, is overcome by Meehanite's machinability in combination with good tensile strength.

In most cases, Meehanite is easier to machine than is cast carbon steel. This, coupled with its uniformity and ease of pouring makes Meehanite a relatively low cost construction metal.

Meehanite is used in ball mill heads, for example, because of its uniformity, anti-galling qualities, and capacity for taking a high polish. Gyratory crusher frames need its strength, resilience and ability to absorb shock.

Highly stressed classifier linkage parts, on the other end of the size scale, use Meehanite because of its strength, machinability and anti-galling quality.

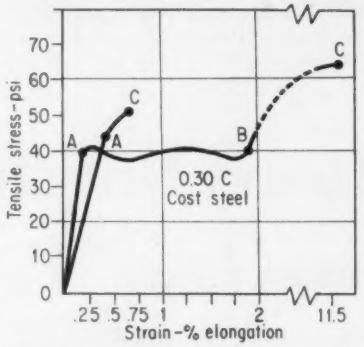


Fig. 6: O-A and A-C are the respective elastic and plastic ranges.

Table I. Comparison of Properties

Properties	Meehanite Types GM	GA	GC	GS	GSF	Typical Cast Iron	Typical .30C Cast Steel
Tensile strength, kpsi 1.2 in. dia bar	55	50	40	80	60	32	78
Modulus of elasticity, kpsi	23,000	21,000	17,500	24,000	23,000	14,000	30,000
Yield strength, kpsi 0.2% offset	46	42.5	34	60	45	25	40
Proportional limit, kpsi	18.5	17	13.5	26	20	—	—
Fatigue strength, kpsi	25	22	17.5	23	21	16.5	24+
Transverse strength, 1.2 in. dia over 18 in. centers							
Load, lbs	33-3700	31-3600	29-3300	n.a.	n.a.	20-2600	
Deflection, in.	.28-.34	.28-.34	.26-.34	n.a.	n.a.	.30	
Compressive strength, kpsi	200	175	150	72	54	120.8	—

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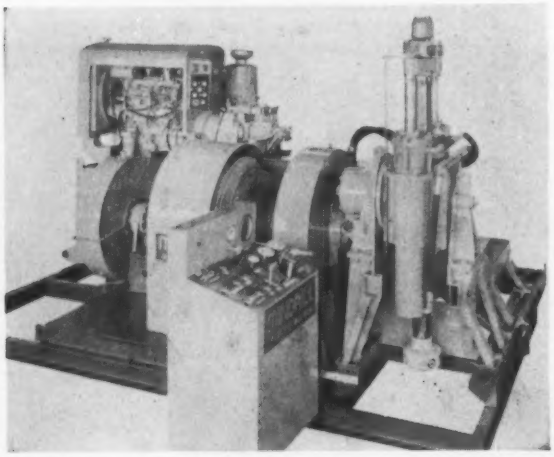
PRACTICE, PROCESS & PATENTS

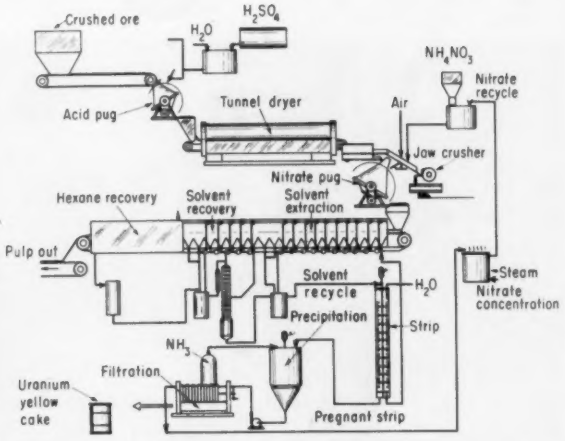


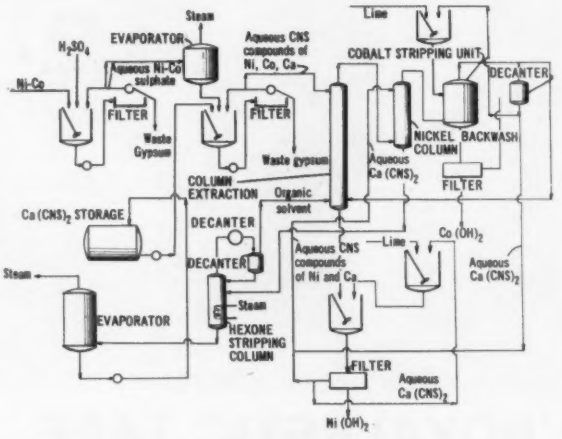
Australians Develop 10,000-ft Diamond Drill

AN AUSTRALIAN-DESIGNED diamond drill capable of going to 10,000 ft in vertical or angle holes has been purchased from Mindrill Ltd., Melbourne, by Kalgoorlie Southern Gold mine of Western Mining Corp. Ltd., Western Australia. Initially, the unit will be used for drilling 2¼-in. holes using an inclineable mast and 60-ft drill rods. The head unit is the largest of its type ever made and is capable of rotating the nearly 2-mile long drill string. Two hydraulic cylinders are used for thrusting and lifting. Power transmitted through a torque convertor (Cummins' 175 hp) and a hydraulic power-shift gearbox. Speed ranges from 200 to 1,500 rpm in either direction. A single-drum hoist is used capable of hoisting 50,000 lb at 300 fpm. A conventional rotary table is used for rotary drilling that permits the use of a driving stem with 10-ft working stroke (vertical holes only). The diamond drilling head employs a revolving quill-shaft geared to advance 33 in. The drill rods pass through the quill and are gripped by a chuck which releases at the end of the stroke; the quill shaft running back for another stroke.

Sidestepping Sand-Slime Separation

BY COMBINING pugging and solvent extraction techniques, uranium may be won from its ores without the necessity of making a sand-slime separation according to Paul Galvanek whose Canadian patent (No. 585,173) has been assigned to the U.S. AEC. In addition to the advantage mentioned, the final product, after calcination, is uranium oxide—better than 99% pure—which needs no further refining.





Solvent Separates Cobalt-Nickel

NICKEL AND COBALT mixtures obtained from any source, including crude salts and concentrated solutions or their sulphides, may be separated with methyl isobutyl ketone, according to a patent granted Richard W. Hyde and George Feick, Freeport Sulphur Co. U.S. No. 2,902,345.

Additional U.S., Canadian and British Patents Briefly Noted

Patent information is provided E&MJ by Oliver S. North, patent consultant, Washington, D. C. Mr. North also scans and abstracts the patents issued in Canada and Great Britain which appear below and which will appear in forthcoming issues of E&MJ. U.S. patents may be obtained from the Commissioner of Patents, Washington 25, D.C. (25¢ each); British patents from the Patent Office, London; and Canadian from the Patent Office, Ottawa, Ontario.

Latest U.S. Patents Releases

Electromagnetic induction surveying. (G. H. McLaughlin and H. A. Harvey; McPhar Eng. Co. of Canada Ltd.) 2,919,396

Measuring electromagnetic radiation. (L. W. Morley, assigned to (Canadian) Minister of Mines & Technical Surveys.) . 2,919,397

Loading water-filled blastholes. (J. F. Barco and D. E. Albon; Airmite-Midwest Inc.) 2,920,523

Beneficiating taconite. (C. L. Kingsbury, Jr. Reserve Mining Co.) 2,919,024

Froth flotation of sulphide ores. The promoter and collector used in a relatively cheap unpurified thiophosphoric ester in solu-

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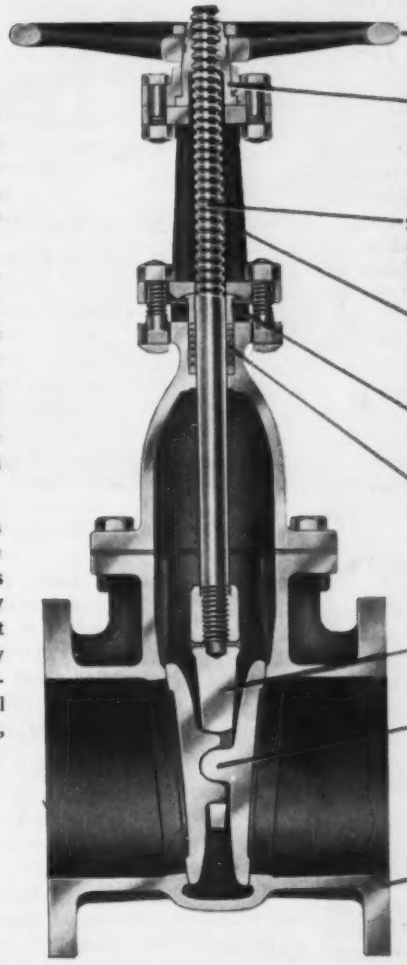

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YOKE BONNET has liberal space between yoke arms for easy access to packing box. Precision machined flange face assures uniform contact with gasket for a tight body-bonnet joint.

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WEDGE CARRIER connects wedge to spindle and raises or lowers it. Husky in size to stand any operating strains.

SPLIT WEDGE is the ball-and-socket design which automatically adjusts to the tapered seating surfaces for positive shutoff. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on seating surfaces and reduce possibility of galling and seizing.

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tion in crude cresylic acid. (R. B. Booth and J. K. Heeren; American Cyanamid Co.) 2,919,025

Control of potassium chloride and sodium chloride slimes during froth flotation of sylvinite ore. (W. A. Smith, C. W. Abernethy and J. M. Downey; American Metal Climax, Inc.) 2,919,026

Manufacturing iron coke. (E. E. Donatti; Koppers Co., Inc.) 2,919,231

Froth flotation of sulphide ores. Sliming is overcome by use of a combination of auxiliary agents including a slime dispersant and a slime depressant. Alkali metal phosphates are suitable dispersants, while mannogalactan is the preferred depressant. (R. T. N. Drake; Sherritt Gordon Mines Ltd.) . 2,919,802

Smelting hematite-containing ilmenite. (L. D. Fetterolf; Quebec Iron & Titanium Corp.) 2,919,982

Direct reduction of iron ore. (J. W. Halley; Inland Steel Co.) 2,919,983

Recovery of sulphate-free potassium chloride from sylvinite ores. (C. H. Fuchsman, J. W. Moore; Columbia-Southern Chemical Corp.) 2,921,678-9

A table of the vibrating type in which the top of the table can be both flexed and tilted to control the flow of the material. (J. Kreta) 2,921,680

Device for removing filter cake. (M. A. Johnson and J. W. Holeman; Kaiser Aluminum & Chemical Corp.) 2,921,685

Preparation of chromic oxide. (F. L. Melvill, one-half asigned to Leonard J. Buck, Inc.) 2,921,838

Two-stage fluidized bed reduction of iron oxide ores. (J. C. Agarwal; U.S. Steel Corp.) 2,921,848

Design for an improved tuyere punch. (W. J. De Villiers and D. Bruckman.) 2,922,175

Monitoring system for automatic feed control for wet grinding mills. (D. Weston and S. W. Daniel; Milltronics Ltd.) 2,922,587

Pelletizing wet iron ore fines without a binder. (H. T. Stirling; Koppers Co., Inc.) ... 2,920,344

Continuous reduction of easily vaporizable metals. (O. Bretschneider, G. Jackel, L. Bender and K. Zieke; Knapsack-Griesheim) 2,920,951

These U.S. Patents Have Expired

Froth flotation of silica, mica, and other silicates from phosphate rock, barite and feldspar. (American Cyanamid Co.) . 2,312,387

Floating silica and mica or other silicates from phosphate rock, barite and feldspar. (American Cyanamid Co.) 2,312,414

Floating phosphate rock and barite. (American Cyanamid Co.) 2,312,466

Production of iron from ilmenite. (H. A. Brassert; Minerals & Metals Corp.) .. 2,313,044

Electrodeposition of sponge zinc. (W. H. Hanney and B. J. Walsh; Cominco) 2,313,338

Floating phosphate rock. (Armour & Co.) .. 2,313,360

Cyanidation of gold—the cyanide-gold-charcoal process. (Eagle-Picher Mining & Smelting Co.) 2,315,187

Canadian Patents

Mixing fine iron ore with high-silicate iron ore fines before fluidization to prevent sticking in the reactor (T. F. Reed; U.S. Steel Corp.) 587,342

Agglomeration of iron ore using liquid hydrocarbon, asphalt cement and ore fines (Subervie) 587,478

An improved electrode for the aluminum reduction cell (W. S. Peterson and D. H Thompson; Kaiser Aluminum) 587,708

Producing a self-fluxing synthetic iron scrap using fine iron ore and lime and heating to 1200 to 1600° F in a fluidized reactor (J. C. Agarwal; U.S. Steel) 587,804

Improved design for an aluminum reduction cell (H. Schmitt and P. Muller; Aluminium-Industries, A.G.) 588,014

Recovering selenium from anode slimes (American Metal Climax) 588,098

Some Recent British Releases

Design for a winding system. (Anglo-American Corp. of South Africa Ltd.) ... 823,035-6

Core drilling process. (F. Demetrescu; Comitetul Geologic de Cercetari si Explorare a Solului si Subsolului.) .. 823,417

Purifying tungsten by a complex recrystallization of the alkali metal paratungstate. (Wah Chang Corp.) 823,043

Recovering manganese from slags. (W. S. Stringham and G. N. Summers, assigned to Bruce Williams.) 823,215

Direct reduction of iron ores. (Inland Steel Co.) 823,493

Cooling finely granular sintered iron ore agglomerates or pellets. (Metallgesellschaft A. G. and Carl Schenck Maschinenfabrik.) 824,074

Separating small amounts of nickel from a cobalt. (Sherritt Gordon Mines Ltd.) . 824,470

Frothing agent for use in the flotation of galena, mixed lead-zinc sulphides, sulphide, carbonate or silicate ores. (Farbwerke Hoechst A.G. vormals Meister Lucius & Bruning) 824,661

Reduction of iron ore. (Texaco Development Corp.) 824,805

Refining lead in a shot-tower device to remove antimony. (British Oxygen Co. Ltd.) 824,216

Calcining and smelting pyrolusite or hausmannite in an electric furnace to produce ferromanganese with 90% Mn recovery (Strategic-Udy) 820,241

Direct reduction of iron using oil injection into the melt as a source of carbon (F. Kocks) 820,351

Dorr-Oliver fluid-bed reactor 820,447

Chloride volatilization of manganese from materials (H. S. Cooper assigned to W. M. Weil) 821,922

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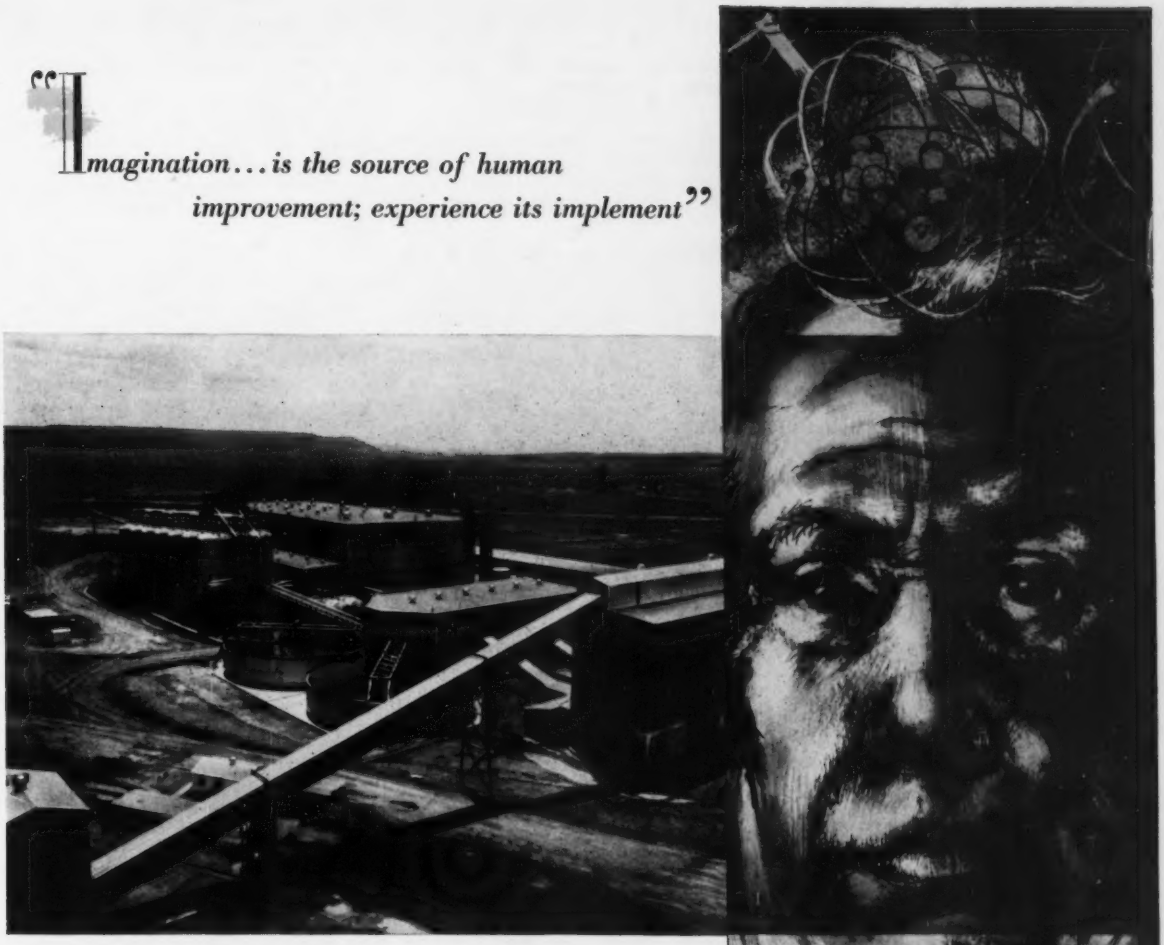

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PERSONALS

Dr. Donald L. Everhart has joined International Minerals & Chemical Corp. as chief geologist in the mining and exploration department.

Everhart

Before joining International, Dr. Everhart spent ten years as chief geologist for the AEC. Prior to that, he was geologist with the minerals deposit branch of the U.S. Geological Survey for six years.

Dr. Everhart is a graduate of Denison University, and got his doctorate in geology at Harvard University.

The Rhodesian Selection Trust Group announced the following appointments which will take effect on April 1:

John H. Lascelles, O.B.E., T.D., now executive vice president, will become resident director in London;

Jack Thomson, O.B.E., now head of the Rhodesian department of an associated company, Selection Trust Ltd. (London), will become resident director in Lusaka, Northern Rhodesia;

Frank E. Buch, general manager of Mufulira Copper Mines Ltd., will join the head office in Salisbury as vice president and assistant to the president;

George B. Brebner, controller of the group, will become a vice president, retaining his office as controller;

Noel M. Kenny, general manager of Roan Antelope Copper Mines Ltd., will become general manager of Mufulira Copper Mines Ltd.;

James L. Reid, manager of Roan Antelope, will become general manager of that company and **H. J. Wedgwood,** assistant manager of Roan Antelope, will become manager of the company.

Harry A. Shaw, assistant to the general manager of White Pines Copper Co., has been named superintendent of the Phelps Dodge refinery at El Paso.

Lewis G. Nonini, after 12 years as mining consultant for various aid organizations in Korea, was named chief engineer of Korean Consolidated Mining Co., Ltd.

Nonini

Before Nonini came to Korea in 1948, he had been an engineering and geology consultant in the Coeur d'Alene district. His subsequent work as consultant to the Economic Cooperation Administration was interrupted by the Korean War. In 1951 he became mining consultant for UNKRA; in 1953, deputy chief of the mining division, and chief in 1954.

Nonini, on assuming his new post with Korean Consolidated, confirmed his previously stated position that Korea's primary mineral asset is gold, and that Consolidated's mining policy would be to continue the emphasis on gold properties.

Orval Webster Adams, Jr., attorney for the Utah Legislative Conference for the past two years, has been named assistant to the president of Hidden Splender Mining Co., Salt Lake City.

Kenneth L. Magnuson has been appointed assistant controller of U.S. Borax & Chemical Corp., according to **Richard F. Steel,** vice president for administration.

James W. Franklin, former associate editor of E&MJ, is now employed as an editor in the publications division, Mohansic research center, International Business Machine Corp., Yorktown Heights, N.Y. Prior to joining E&MJ as an assistant editor in 1955, he was a representative for the consulting metallurgical chemist firm of Lucius Pitkin, Inc., and had been a development chemist for Pennsalt Chemical Corp. Franklin co-authored (with D. P. Eigo and George H. Cleaver) the article "Lithium" which won a merit award in the 1955 Jesse H. Neal competition for outstanding technical journalism. In 1958, he won a second merit award for "Electrons & Ions." Franklin is an associate member (1954) of the AIME, and a member of the Electrochemical Society; and was a charter member and director of the Uranium Institute of America.

Franklin

Frank B. Jewett, Jr., executive vice president, has been elected president of Vitro Corporation of America, succeeding **J. Carlton Ward, Jr.** who has been named chairman of the board of directors.

At the same time, **Charles S. Payson,** the retiring board chairman, was elected to the new office of chairman of the executive committee of the board of directors.

Mr. Jewett joined Vitro in 1956 after eight years with General Mills Inc. where he was managing director of engineering, research and development. Before that, he was vice president of National Research Corp. and manager of its vacuum engineering division. Mr. Jewett served as a vice president in charge of chemical operations from 1956 to 1959 when he was named executive vice president.

Dr. Richard M. Foose, chairman, department of earth sciences, Stanford Research Institute, Menlo Park, Calif., has returned from Geneva where he served as one of the technical experts to the U.S. Delegation Conference on Nuclear Test Suspension, Nov. 25 to Dec. 19.

Joseph L. Gillson, president of the AIME, retired Feb. 29 as chief geologist for the Du Pont Co.'s development department.

He joined Du Pont in 1929, and, as chief geologist in the development department, made explorations in search of sulphur, ilmenite, fluorspar, barytes, and celestite.

Dr. Gillson was president of the Society of Economic Geologists for 1959 and is a former president of the American Geological Institute, a fellow of the Geological Society of America, and a fellow of the Mineralogical Society of America.

In 1957, he received AIME's Jackling Award for "his significant contributions to the advancement of economic geology, his leadership, his keen sense of professional responsibility."

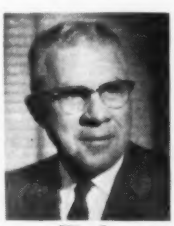
The board of directors of the Beryllium Corp. recently elected **Lawrence F. Boland** to be the firm's executive vice president.

Mr. Boland was previously vice president and is a director of the parent company as well as a director of Nonotuck Mfg. Co., a wholly owned Beryllium subsidiary, and of Consolidated Beryllium, Ltd., Avonmouth, England.

H. Myles Jacob was recently elected president of Inspiration Consolidated Copper Co. at a meeting of the board of directors. He succeeds **Pharic D. I. Honeyman,** who is retiring. Inspiration also announced that **H. Carroll Weed** had been elected a director and vice president. Mr. Weed will also continue as the general manager of the company.

Jacob

Mr. Jacob joined the company as an accountant in 1936. He became secretary-treasurer in 1947, and, in 1953, was elected a director—two years later became vice president and secretary. Since 1957, Mr. Jacob has been executive vice president of the company.



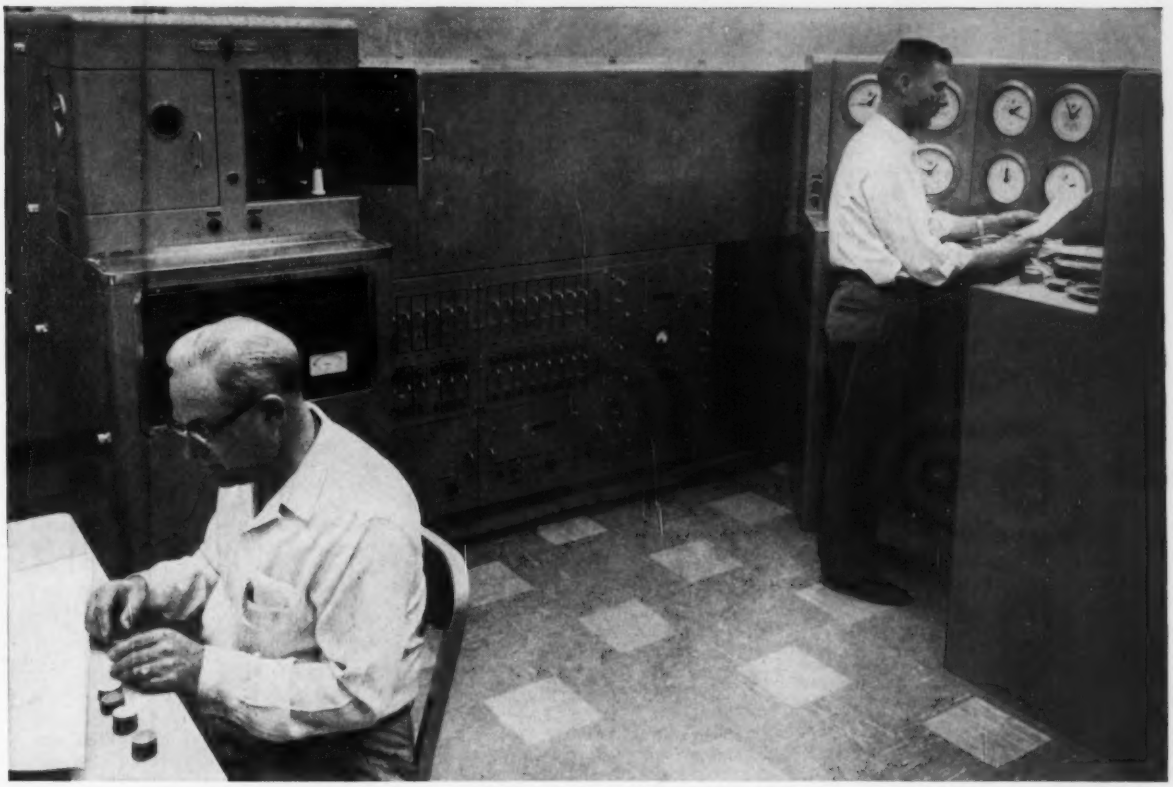
Weed

Honeyman

Mr. Weed started at Inspiration in 1937 as a mine shift boss. He later became shift foreman, assistant mine superintendent, and in 1944 was made general superintendent. In 1950, he was promoted to assistant general manager, a position he held for eight years.

P. D. I. Honeyman, the outgoing president, though born and schooled in Canada, has been active in Arizona mining since 1922. He started as a testing engineer at the Miami smelter of International Smelting & Refining Co., and eventually became smelter superintendent.

In 1942, Mr. Honeyman assumed the position of general superintendent of



Accurate to one ten thousandth of one percent. With this new "Direct Reader" Spectrograph, CF&I maintains extraordinary control over each melt of steel. Samples, taken from the blast furnace or open hearth, are sped to the lab via pneumatic tubes. In minutes, a complete spectrographic analysis is ready. This "controlled chemistry" means Grinding Balls and Rods that wear longer, grind more efficiently.

What CONTROLLED CHEMISTRY means in CF&I Grinding Balls and Rods

CF&I takes great care in the selection of steels used in its grinding balls and rods. For example, each size ball from the smallest to the largest (¾" to 5" diameter) must have the proper composition to give the best balance between hardness and toughness. CF&I's modern spectrographic equipment assures you balls with the correct chemistry in relation to their size. In fact, CF&I uses different steels, depending on the ball size required. This chemical control pays off in your mill because CF&I balls have greater resistance to abrasion, withstand impact, and grind at lower cost.

In grinding rods, CF&I observes similar standards. Special analyses of high carbon steels are hot-rolled and machine-straightened to close tolerances, from 1½" to 4" diameter in whatever lengths ordered. CF&I's controlled chemistry techniques result in grinding rods that have excellent wearing properties, resisting bending or premature breakage.

For the complete story on the advantages of CF&I Grinding Balls and Rods, get in touch with your local CF&I Sales Office.

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MINING PRODUCTS

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In the East: **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston • Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

Personals (*Continued*)

Inspiration Consolidated; soon became a director and vice president of the company; later became president. He is also a director of Apache Powder Co. and the Valley National Bank. He will be retained by Inspiration Consolidated as a consultant.

Christian F. Beukema has been appointed president of Oliver Iron Mining Div. of U.S. Steel Corp., succeeding the late Rudolph T. Elstad.

Beukema

For the past five years, Mr. Beukema has been president of USS's Michigan Limestone Div. He joined that division at its calcine plant, Rogers City, Mich.

In July 1949, Mr. Beukema was transferred to Pittsburgh as special assistant to U.S. Steel's vice president—raw materials and was made director of planning in the raw materials division in 1951. He returned to Michigan Limestone in 1953 as general manager of operations at the division's headquarters in Detroit.

Mr. Beukema was appointed vice president of Michigan Limestone in 1954 and president in 1955.

Lewis J. Patterson was recently appointed vice president—operations, for Quebec Cartier Mining Co.

Patterson

In his new post, Patterson will direct the operations of the iron ore project that the company is presently undertaking in Quebec's Saguenay County.

Before coming to Quebec Cartier, Patterson had been associated with the Michigan Limestone Div. of U.S. Steel Corp. His last position with that firm was as manager—northern district.

Norbert F. Koepel, Vincent D. Perry, and **Richard B. Steinmetz** have been elected to the boards of directors of Anaconda Co. subsidiaries to fill vacancies left by **Russell B. Caples,** who retired at the beginning of the year.

Koepel

Mr. Koepel was elected to the board of Anaconda's two principal subsidiaries with operations in South America; Andes Copper Mining Co. and Chile Exploration Co. He has been vice president of the two subsidiaries since 1958.

During the years that he worked for Andes Copper at Potrerillos, Chile, Mr. Koepel held a number of engineering and administrative positions and became general manager of the entire operation in 1947. From 1948 to '55, he was Anaconda's assistant general manager of South American operations, and then became assistant to the vice president of Chile Exploration Co. and Andes Copper Mining Co.

Perry

Steinmetz

Mr. Perry has been elected to the board of directors of Greene Cananea Copper Co., a 99%-owned subsidiary. He has been associated with Anaconda's mining and geological activities since 1922. Here are some of the positions he has held with the firm: chief geologist, Cananea Consolidated Copper Co.; chief geologist, International Smelting & Refining Co.; and assistant chief geologist, Anaconda Copper Mining Co.

Since 1957, Mr. Perry has been vice president and chief geologist for Anaconda. Mr. Steinmetz, president of Anaconda Wire & Cable Co. is now on the board of two wholly-owned Anaconda fabricating subsidiaries, the American Brass Co. and Anaconda Aluminum Co.

In 1948, Mr. Steinmetz was made manager of the firm's Marion, Indiana mill, and then, in the years before becoming president in 1959, was general manager of mills, vice president in charge of manufacturing operations, and executive vice president.

Professor J. T. Whetton, head of the mining department, University of Leeds, Yorkshire, England, is presently spending eight weeks in Canada on a visiting lectureship in sciences sponsored jointly by the Nuffield Foundation of Great Britain, the National Research Council of Canada, and the universities concerned. While in Canada, Professor Whetton will visit the mining engineering departments of McGill University, Queen's University, and the Nova Scotia Technical College. He'll also tour the Sudbury and Elliot Lake area of Ontario, and the Sydney area of Nova Scotia. After his Canadian visit, the professor will stop briefly at Columbia University, N.Y., before going on to Trinidad to visit the Shell Oil Co. operations.

Whetton

James A. Briggs has been named manager of the New Cornelia Branch of the Phelps Dodge Corp. at Ajo. He succeeds **Alfred T. Barr,** who retired after 37 years at the Ajo mine.

Dr. Howard L. Hartman, professor and head of the department of mining, Pennsylvania State University, has been awarded a $32,000 National Science Research grant to study the mechanics of brittle rock under impact loading.

Hartman

The purpose of the research, being conducted in Penn State's rock mechanics laboratory, is to discover the mode and sequence of rock failure under an impact blow. During the first stage of research, Dr. Hartman will study the mechanics of brittle fracture in rock under single impact blows. Synthetic and natural stone will be employed with suitable stress instrumentation and high-speed movie photography to record the sequence of failure. The final research phase will involve research on the behavior of rock under multiple blows, from low to very high frequencies.

OBITUARIES

John E. Williams, 56, regional manager for the Linde Co. division of Union Carbide Corp., died Dec. 11. He had much to do with development of oxygen jet piercing for taconite blast holes.

Tony Jacobson, 66, president and general manager of Wasatch Mines Co., died of a heart ailment on Jan. 20.

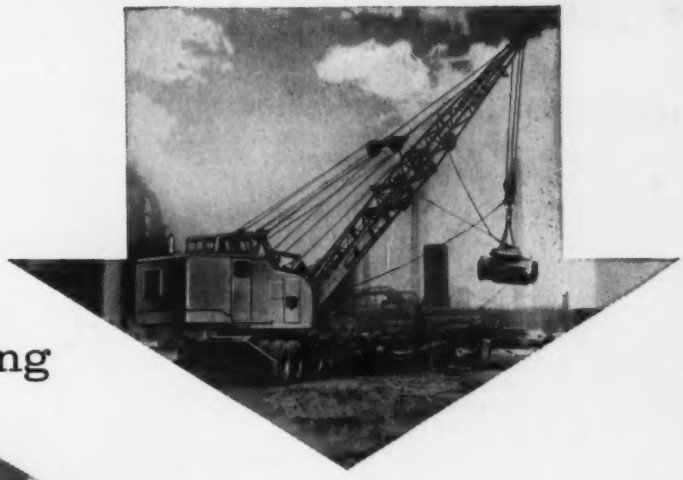
Mr. Jacobson had operated lead-silver-zinc mines in Alta Brighton districts (just east of Salt Lake City) for more than 45 years.

J. A. Mecia, 42, and **H. A. Mann,** 50, two top executives of Utah Construction & Mining Co., were killed Jan. 13 when their executive plane crashed near Milford, Utah, on a routine business flight.

Mr. Mecia was general vice president and manager of the mining division of Utah. Mr. Mann was director of mining services for the company.

In addition to his activities in the mining division, Mr. Media was vice president of five of the corporation's subsidiaries: Lucky Mc Uranium Corp.; Utah Development Co.; Mt. Andrew Mining Co.; Prince of Wales Mining Co.; and Utah Co. of the Americas. He was a member of AIME and was active in the American Mining Congress and the Wyoming Mining Association.

Mr. Mann graduated from the University of California in 1935 as a mining engineer. He worked in the Philippines as a mining engineer after graduation, and stayed behind to fight as a guerilla during the Japanese occupation. He joined Utah in 1953, and served as assistant secretary of the Utah Development Co.; the Mt Andrew Mining Co.; the Prince of Wales Mining Co.; and the Utah Corp. He was a member of AIME, the Denver Athletic Club, Engineers Club of SF, American Mining Congress, and the Wyoming Mining Association.



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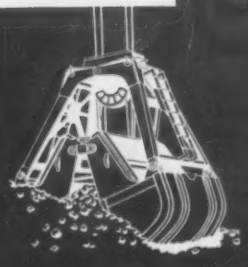

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OPERATING IDEAS

Accurate, Easy-to-Use Detector Spots Beryllium Ore in the Field

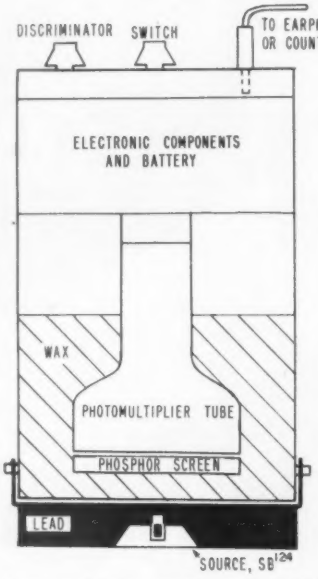
A PORTABLE, accurate detector, the Berylometer, may become as basic an exploration tool for beryllium as the geiger counter is for uranium, according to a paper read at AIME's recent convention in New York.

Here's how the Berylometer works. Inside the detector are 80 millicuries of antimony 124, which emit "hard" gamma rays. These convert ordinary beryllium (Be^9) to Be^8—forcing it to give up a neutron. The released beryllium neutron is then counted by a scintillator designed to favor neutron responses while suppressing those of gamma rays.

The Berylometer was developed by Nuclear Enterprises Ltd., Winnipeg, Canada; is manufactured and sold in the U.S. by Nuclear Corp. of America's western division at Burbank; and was described at the AIME meeting by Louis and Pauline Moyd, consulting geologists.

Main advantages of the detector, according to Nuclear Corp. of America, are that it: 1. provides immediate rough field analyses; 2. will only react for beryllium; 3. will be able to prove the absence of beryllium that had been mistakenly indicated by other detection procedures.

The actual device, Nuclear Corp. said, is an 8x13-in. cylinder which weighs about 11 lb. Gamma ray source (antimony 124) is attached to a lead shield at the base of the detector. Neutrons penetrate the Berylometer, pass through a ½-in. wax layer designed to moderate



them, and then produce strong flashes as they strike a 5-in. boron-enriched polyester - zinc - sulphide fluorescent screen. No such reaction takes place when gamma rays penetrate the screen. The instrument's photomultiplier tube and electronic circuit (with a 7½-volt dry battery) convert neutron flashes to electrical impulses which are then recorded. Gamma ray effects are almost completely eliminated while a variable discriminator permits adjustment for maximum efficiency as the gamma ray source ages (antimony 124 has a sixty day half-life).

To conform to safety regulations, the 14-lb protective lead shield is detached and put in a lead shipping container when the instrument is not being used.

Nuclear Corp. went on to say that, for effective field work, the first step, after having assembled and mounted the Berylometer, is to determine the gamma ray background count in a beryllium-free area. Background impulses range from 5 to 25 per minute, depending on the strength of the source, the discriminator setting, and the temperature. Once the machine has adjusted to the temperature, the background counts remain fairly constant, within two or three per minute. In the same beryllium-free zone, a 0.5% standard sample is centered under the instrument for a one or two minute count.

As soon as the Moyds came to a potential beryllium area, they undertook separate exploration duties. While one of them made timed counts, the other went ahead to prepare the next site. They never stayed longer than 15 seconds at any given site unless the reading rose above the background range.

While still in the field, the couple got rough assays by crushing samples and putting them in cans similar to those that contained the standard. They then made counts of up to five minutes and subtracted the background counts before ratios were determined.

Gas Turbine Powers Ore Hauler

A 225-HP REGENERATIVE gas turbine engine, said to have more than double the power of a comparable piston engine per unit volume and approximately 70% more power per lb, has been installed on a haul truck at International Nickel Company of Canada Ltd.'s Sudbury open pit.

The engine is the GMT-305 Whirlfire, made by General Motors' Allison Div., and Inco stated that this is the first time an automobile gas turbine has been used for open pit ore haulage.

"The concept of more usable horsepower is a direct result of the torque characteristics of the dual shaft gas engine. The torque characteristics result in a broad horsepower curve which allows the turbine engine to be operated over a wide range of speeds with a minimum loss of power." The company also said that the ability to maintain maximum horsepower over a broad range makes possible the use of fewer speed changes in the transmission.

Although the crushing plant at the Sudbury pit is only about 1,000 ft from the shovels at the pit floor, the 32 ton capacity turbine-powered truck will have to travel almost two miles over a winding 8% grade haul road.

The hauler also seemed to have satisfactorily endured the severe Sudbury weather. "The GMT-305 engine has been started, after extended cold soaking, at about —45°F in about 30 seconds. In fact, it can be started even at temperatures as low as 65°F."

Inco went on to say that approximately 30 lb of nickel are used in the alloys of the prototype engine. The highest percentage of nickel-containing materials is used in the hot end components—the turbine blades, turbine wheels, combustion chambers and nozzle vanes. The regenerator, which operates at a lower temperature, also relies heavily on nickel-containing alloys.

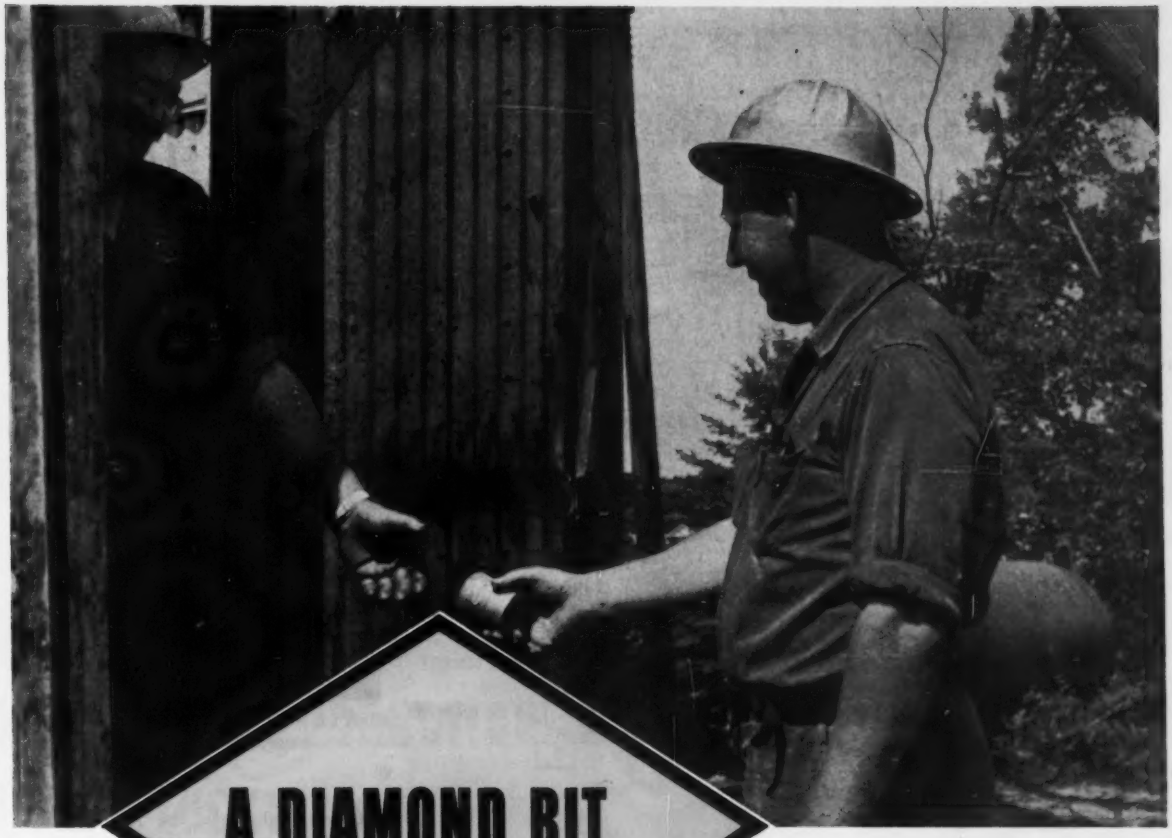
Jacketed Pipe Handles Slurry

A SERIOUS CORROSION PROBLEM was solved last year at Jones & Laughlin Steel Corp.'s Pittsburgh Works when the firm began using 350 ft of steel-jacketed plastic pipe to carry a corrosive slurry of powdered coal and water. The high sulphur content of the slurry made it much too corrosive for any standard pipe that the company had up to that time been using.

The new pipe, developed by engineers at the J&L Product Development division and Electricweld Tube division, was called Jal-Jacket and consisted of a rigid polyvinyl chloride lining encased in a steel jacket. Its plastic lining gave it resistance to a broad range of corrosive liquids, and the steel jacket gave it strength to carry fluids or gases under high pressures.

For more than six months, a three-in. Jal-Jacket line carried coal slurry over the 350-ft route. Not a trace of corrosion developed. During the same period, J&L engineers said, unlined pipe would have broken down.

In addition to being corrosion resistant, the pipe had another advantage—it could be installed quickly and easily. Mill-rolled grooves at pipe ends enabled lengths to be joined by grooved couplings. These locked into place to form a positive seal at the joints—permitted an installation to be dismantled and reassembled without damaging the lining.



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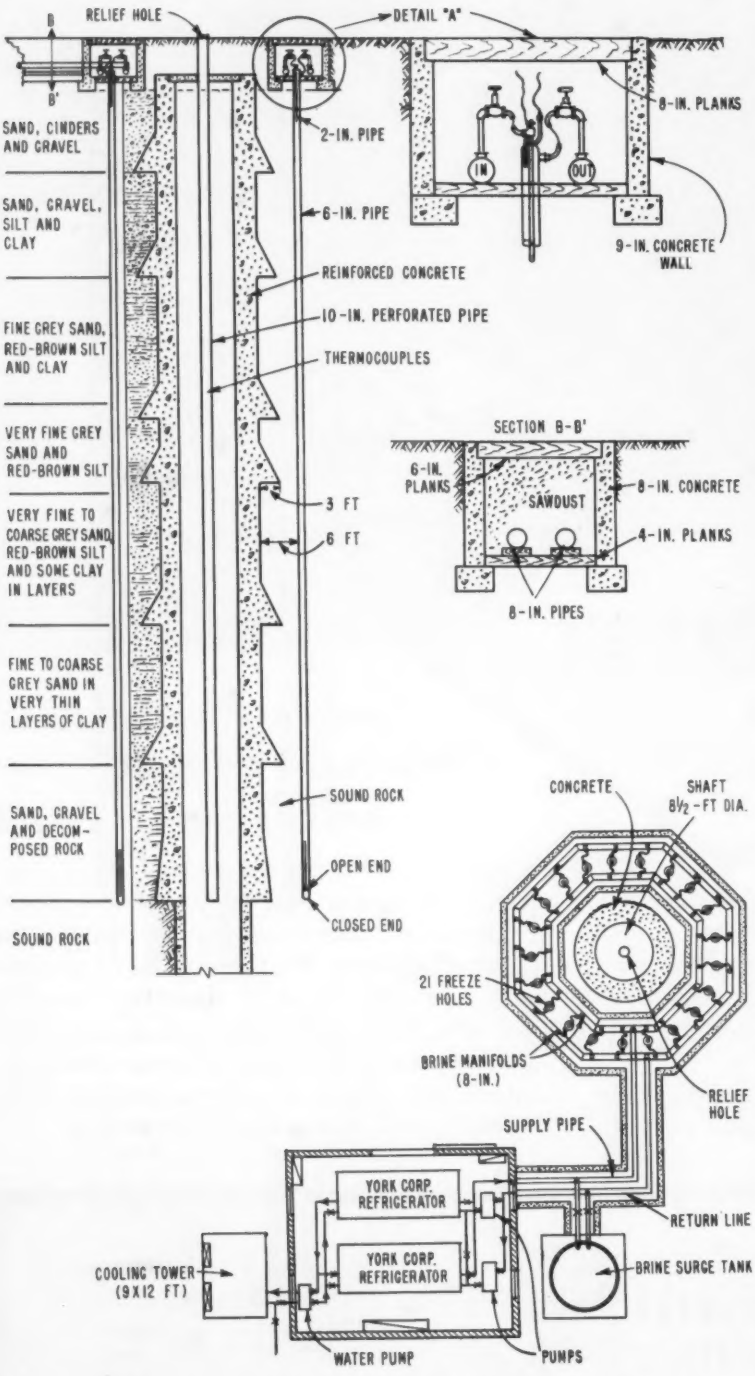
Freezing-Sinking "Comes to Town"



AN ARTIFICIALLY frozen column of marshy soil, 123-ft deep and 40-ft dia, was employed recently here in New York City by Poirer & McLane Corp., general contractors, to start a shaft sinking for a pollution control program. The shaft was started down on the west bank of the East River by Winston Bros., practitioners in the art of freezing-sinking.

SIMPLE form enabled sinking crew to determine proper offset depth and angle.

Considered to be the first use of the method in the eastern part of the U.S., the method will permit Poirer & McLane to drive through 123 ft of sand, soil and clay safely and quickly, without the use of caissonning or costly pumping (which might lower the water table in the vicinity and disturb the foundations of neighboring buildings). Mucking was done with a clam-shell on a wheeled crane.

Two York Div., Borg-Warner Corp., 55-ton reciprocating ammonia-brine chillers provided the freezing mechanism and were set up as illustrated in the drawings at left. The York System supplied 17° F brine through 8-in. inlet (and outlet) manifolds to 21 freeze holes. The holes, drilled by Pennsylvania Drilling Co., were spaced at about 4-ft intervals on a circle having 26½-ft dia. In the holes, a 2-in. dia pipe was inserted in a 6-in. dia pipe that had its bottom end closed.

After completion of the concrete lining, the shaft will have an 8½-ft dia and will be extended through bedrock under the river. Thermocouples were used at the inlet and outlet of each freeze hole and in the central relief hole (spaced at 10-ft intervals down the hole) to check on conditions of the freezing operations.

As indicated in the drawings, concrete was applied in various lengths, using forms to provide a 3-ft concrete lining with a 3-ft offset collar.

14 CAT DW20 RIGS HELP SPEED PRODUCTION IN THE LUCKY Mc URANIUM MINE!

Located in isolated Gas Hills, Wyoming, the Lucky Mc Uranium Mine is classified as a medium-large open pit installation. Ore deposits occur from surface to depths of 500 feet. Overburden is composed mainly of loose sands and sandy shales. The stripping contractor, Utah Development & Mining Co., operates a fleet of 18 tractor-scrapers to haul this material. Mainstays of the fleet are 14 four-wheeled Cat DW20 rigs. Working 20 hours a day, 6 days a week, the fleet averages 30,000 yards a day on hauls of ¼ to ½ mile with maximum 6% grade. Two Cat No. 12 Motor Graders maintain the haul roads to keep the scrapers rolling.

Just as at Lucky Mc, the DW20 Series G Tractor and No. 456 Scraper is ready to deliver faster cycles and bigger loads on your job. Here's why: it packs 345 HP (max. output) and 12% higher rimpull compared to the former model. This increased rimpull provides up to 20% faster travel speeds under similar conditions. The new No. 456 Series B LOWBOWL Scraper has 8% greater capacity—19.5 cu. yd. struck; 27 cu. yd. heaped. There's also a new No. 482 Scraper, with a capacity of 24 cu. yd. struck; 34 cu. yd. heaped.

New optional SynchroTouch Transmission Control

Now optional for the DW20, the SynchroTouch Transmission Control is an advanced new way to shift gears faster and easier. The operator simply dials desired gear for automatic, split-second, touch-and-go response. Result: faster cycles and more payloads per hour.

With all its improvements, the new DW20-No. 456 meets your needs for moving more dirt at lower cost. See this high-capacity hauler at your Caterpillar Dealer. Ask him to demonstrate. Pick a tough job—watch it handle the hard work!

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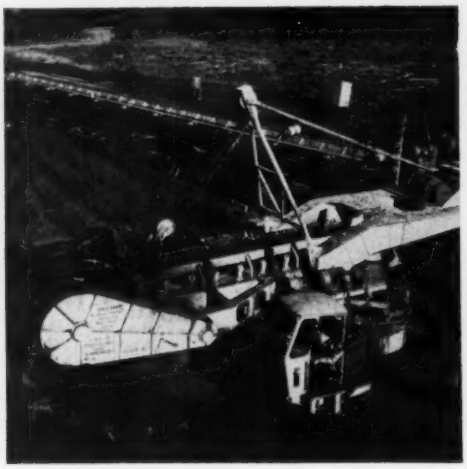
HAUL AT LOWEST COST PER CU. YD.

THE PILOT PLANT at Mildred Lake, which is treating the diluent from the washed sands, is the basic step in the huge research project.



NINE-FOOT digging wheel cuts into the unconsolidated sand. Conveyors haul to the washing plant.

Four Companies Challenge Athabasca's Oil Sand

THE MOST comprehensive research project ever undertaken to release liquid hydrocarbons from the Athabasca oil sands of northern Alberta has been announced coincident with the formation of a four-company partnership to carry forward the enterprise.

The four companies are Imperial Oil Limited, Cities Service Athabasca, Inc., a subsidiary of Cities Service Co., which will operate the project, Richfield Oil Corp. of Los Angeles, and Royalite Oil Co., Ltd.

Imperial, Cities Service and Richfield will each hold a 30% interest in the partnership. Royalite's interest will be 10%.

The Athabasca oil sands comprise the world's largest known reserves of hydrocarbons. They are located some 300 miles north of Edmonton along the banks of the Athabasca River. Areas in which the sands are at or near the surface contain in excess of 40-billion barrels of recoverable oil, about the same amount as the proved crude oil reserves of North America. In other areas, the sands, deeper under the surface and with varying depths of overburden, contain vast additional reserves.

Research activities have been carried on individually by the partners for several years, searching for a method of extraction of oil from the Athabasca sands on a commercially feasible basis. The present research program was begun two years ago by Cities Service. Subsequently, a $3.5-million pilot plant was built at Mildred Lake, roughly 30 miles north of McMurray.

The plant includes a 3,000-barrel-per-day distillation unit, extensive separation equipment and numerous collateral facilities. A mining "wheel," which has proved highly successful in the surface mining of coal in Europe, strips the sand from the surface.

The diesel-electric experimental wheel now being used can handle 9,600 cubic yd of material per day. The 9-ft dia digging wheel is installed on a 20.5-ft boom. On this wheel are fastened six 1.8 cubic ft buckets with hard-surfaced, erosion-resistant, cutting edges. The machine also has a tail boom, 38 ft long, carrying the far end of the conveyor belt. Current for the unit is produced by a Deutz diesel generator set-mounted on a trailer.

The present extraction equipment has been designed as a portable, self-propelled unit, which will operate in the field along with the mining equipment.

The sequence of operations is as follows: the bituminous sands are delivered by the belt conveyor from the bucket wheel to the extraction unit, where the first step consists of separating rocks and foreign material. The second and basic extraction process consists of using a diluent—produced from the bitumen itself—to reduce the viscosity and specific gravity of the bitumen. Water is then added, causing the sand to precipitate, freeing the diluted bitumen for subsequent processing. The precipitated, oil-free sand is discharged to the escarpment area.

Based on bench scale results and engineering estimates to date, Athabasca researchers believe that it should be possible to design facilities to separate the bitumen at a reasonable cost and eventually produce fuel for Western Canada.

IM&CC Will Try "Tubbing" at Esterhazy

A MINING TECHNIQUE proven in Europe but new in Canada is being imported by International Minerals and Chemical Corp. (Canada), Ltd., for its potash mine at Esterhazy in east-central Saskatchewan.

The new technique, called "tubbing," employs cast iron lining for the mine shaft.

International Minerals, like other potash companies in the province, has experienced considerable difficulty with seepage of formation water when penetrating in Blairmore sands below 1200 ft. The potash beds lie at the 3100-ft horizon.

Refrigeration of the sands to permit lining of the shaft with reinforced concrete, previously considered by International Minerals, will now be superseded by tubbing. The lining, to weigh some 3000 tons, will be used between the 1200-ft and 1500-ft levels to wall off the water-bearing sands.

I. M. Lebaron, vice-president of the company, said a $750,000 contract is being let to John Bertram and Sons, Dundas, Ontario, to supply the lining.

The shaft is already down to the 1200-ft level and present operations involve consolidation of the sands by refrigeration. Freezing will also be employed to consolidate glacial till before sinking the first 300 ft.

Delivery of the cast iron rings to the property is expected to start in May when sinking will be resumed from the 1200 level. Three months will be required to complete the job through the Blairmore sands, after which normal sinking will start.

Present plans are to begin production

Your new plant or expansion idea

Raw materials available?

Market available?

Location correct?

Capacity adequate?

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• KE projects include work in Australia, Brazil, Ghana, India, New Zealand, as well as Canada and the United States. Assignments include iron ore concentrating plants, cement plants, bauxite and alumina processing plants and diatomaceous earth facilities.

5469-M

Tubbing *(Continued)*

late in 1961 at the rate of 1150 tpd.

The tubbing to be used in the Blairmore area actually will consist of 65 rings, each 5 ft high, 18 in. thick, and 18 ft in diameter. Each ring is made up of 11 segments.

Mesabi Iron and Reserve End Taconite Dispute

NEGOTIATION between Reserve Mining Co. and Mesabi Iron Co. has finally led to successful settlement of their long-standing property and royalty dispute, according to Arnold Hoffman, president of Mesabi.

Highlights of the agreement include payment by Reserve of all remaining pre-production expense, hitherto charged to Mesabi. Obligations of Reserve to make further payments for pellets produced prior to Jan. 1, 1960, are eliminated. Reserve returns its Mesabi stock and pays the latter $400,000.

Commencing Jan. 1, 1960, Reserve will pay $1 per ton on "all iron product shipped," with escalation clauses; Mesabi agrees to specified reductions in royalties above the 6-million tpy of pellets which is Reserve's capacity "to encourage expansion of mining and treatment facilities at Babbitt and Silver Bay, Minn."

DRILL LARGE DIAMETER HOLES THE MODERN WAY . . . WITH

SPANG FABRICATED STAR BITS

Progressive Operators Everywhere Are Discovering This Modern, Better Way Of Drilling Large Diameter Holes.

SPANG FABRICATED STAR BITS replace the conventional, old-style spudding bit and the big hole paddle-type bit. They are made in large diameters for drilling hard formations, and can be dressed, ready for drilling, by hard surfacing quickly and economically, thereby saving the time consumed heating and ramming. Made in a variety of diameters, lengths and weights, with any size joint desired, SPANG Fabricated STAR BITS are your assurance of profitable **big hole** drilling.

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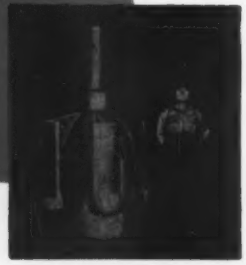
SPANG PILOT-TYPE REAMER BITS ARE RECOMMENDED



PILOT-TYPE REAMER BIT

Field performance has amply proved these bits to be the driller's answer to **large hole** problems. They are made special, to your specifications and design, in any diameter; size and weight limited only by the handling capacity of conventional drilling rigs. They can be furnished to run on drilling stem or with integral rope socket top.

For detailed information on SPANG Fabricated STAR BITS and SPANG PILOT-TYPE REAMER BITS for big hole drilling, plus 52 page CATALOG, consult your nearest SPANG DEALER or write direct to

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Wilson Succeeds Romney As Lead-Zinc Chairman

CLARK L. WILSON, vice president and operations manager for New Park Mining Co., Salt Lake City, has been named chairman of the National Emergency Lead Zinc Committee.

He succeeds another Utahn, Miles P. Romney, manager of the Utah Mining Assn.

Mr. Romney held a dual role as lead zinc committee chairman and Utah mining group manager. He told E&MJ that his work in Washington in recent months convinced him that the chairmanship of the lead zinc group was a full-time obligation.

Mr. Romney organized the preparation of testimony in the latest investigation of lead zinc imports by the U.S. Tariff Commission. He said that the next problem of the committee is to secure Congressional action on the recommendations which will be coming from the Commission prior to March 31, 1960.

Clark L. Wilson

Presumably, this will be Mr. Wilson's principal work at Washington headquarters of the committee. The committee represents 90% of the domestic mine production of lead and zinc.

The new chairman is a native of Cripple Creek, Colo., who holds B.S. degree in geological engineering from the University of Utah and M.S. from University of Arizona in geology.

Following early work in the 1930's for Missouri Monarch Consolidated Mines Co. at Black Forest district, Nev., and as a geologist for Utah Copper Division, Kennecott Copper Corp., at Salt Lake City he joined New Park in 1940 as chief engineer and geologist. In 1947, he was promoted to superintendent of New Park and since 1952 has been vice president and operations manager of the Park City lead-silver-zinc producer.

Major Southern quarry chooses Michigan Tractor Dozer for top-production job

375 hp model feeds 550 tons hourly to pug mill

At its top rate, this Michigan Tractor Dozer moves 550 tons of crushed stone an hour!

Pushes, one-way, range up to 150 feet.

Same unit also cleans spillage around two rock shovels located ½ mile away.

It alone does the work of two 50,000 lb class crawler dozers.

Owner: Lambert Brothers Division of Vulcan Materials

The Dozer is a 375 hp, 74,000 lb Model 380 Michigan. It is owned by Lambert Brothers Division of Vulcan Materials Inc, Birmingham, Alabama, one of the nation's largest stone producers. The Lambert Division alone operates 25 quarries in Tennessee, North Carolina, Kentucky, and Virginia—most of them Michigan-equipped—they are using this Dozer in their 80 acre pit near Nashville.

The story starts last summer. Harold and Glen Lambert had just installed the pug mill and needed something to feed it. Their existing crawler dozer wouldn't do; it obviously didn't have the mobility to do both pit cleanup and mill feeding. Another big *crawler* would be needed, it seemed. Then Nashville distributor McCarthy, Jones & Woodward suggested a rubber-tired Michigan Tractor Dozer. One was tried. The problem was solved. From four available sizes, a 375 hp model was chosen as best suited to the need (the other size Michigan Tractor Dozers: 162, 262, 600 hp).

Main jobs: feed mill, clean around shovels

The 375 hp machine has been busy ever since.

Most of the time it works at the pug mill—dozing out into a stockpile from the feeder belt when the mill isn't running—feeding when the mill is running at a higher rate than available plant production.

Four to eight times a day, the 25 mph Michigan leaves the mill and drives down blacktopped roads to the quarry for shovel cleanup. Unit makes the ½ mi trip, which took crawlers 20 minutes or so one-way, in 2 to 3 minutes.

50% cut in shovel cleanup time

In the pit, the Michigan saves more time (and money). Back in Lambert Brothers crawler days, a good operator could clean the spillage around one shovel in 5 or 6 minutes. Today, their high-speed Michigan does each cleanup in 2 to 3 minutes.

Sound worthwhile for *your* job? Why not check first-hand? Drop us a line—or call—we'll show you a Michigan Tractor Dozer in action so you can judge its advantages for yourself.

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Tandem trailer units, with a Mack LRX Model doing the hauling, keep the pressure on 3¼-yard electric shovel at the Maryland quarry of North American Cement Corporation.

MACK
for over 7 straight years
NO. 1
by far in sales of
diesel trucks

Maneuverability and ease of handling are Mack features which have made them favorites for heavy-duty quarry work. Here 28 tons of rock is unloaded at the crusher located a half-mile from quarry face.

At the Security Plant of North American Cement Corporation...

TWO MACKS

handle half a million tons of rock per year

North American Cement Corporation has jumped hauling capacity and still kept down costs at its Security Plant in Hagerstown, Md., by coupling full trailers with LRX Model Macks. Each of the two rigs now handles 28 tons at a clip—together they will move 500,000 tons of limestone this year.

The quality of Mack-built engines, transmissions, and clutches helped sell North American Cement on Macks—for, like suspensions, rear axles and other vital components, they are engineered and built by Mack for Mack trucks alone. Mack has manufactured its own components—to the highest standards in the industry—for over 60 years. Manufacturing craftsmanship and the famous Mack practices of Balanced Design account for the fact that a Mack truck will stand up under fast-moving shovels, heavy loads and poor going better than any vehicle in its class. Wouldn't these qualities be valuable in your operation? Your nearest Mack branch or distributor is the man to see. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

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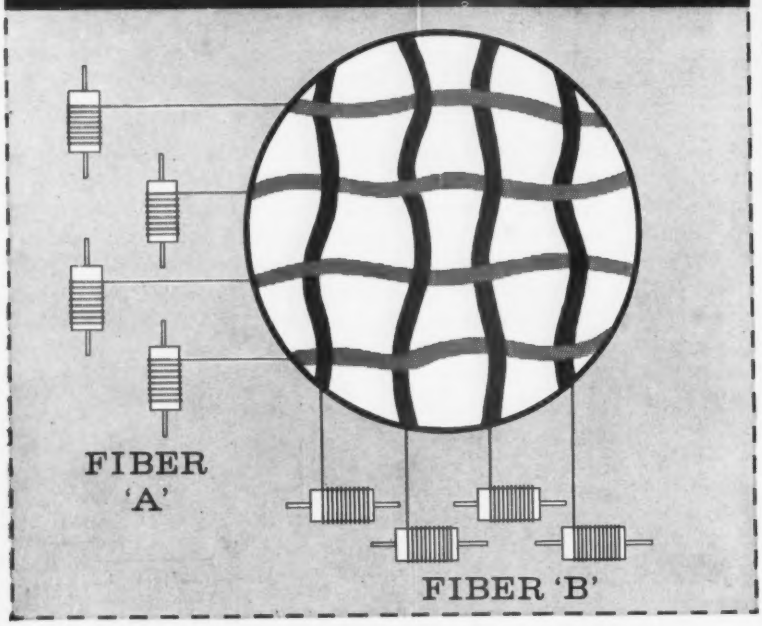

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Venezuelan Iron Ore Concession Is Recalled

VENEZUELA is cracking down on foreign iron ore mining companies, and studying the possibility of setting up its own company to develop the rich Cerro San Isidro iron deposit.

At the same time, Congress is debating a new minerals law which is expected to increase taxes on mining operations, while clarifying legal dispositions governing mining activities. (See "Venezuela" this issue.)

A government decree recently recalled 6175 acres of iron ore concessions held by the Maria Luisa Ore Co., joint subsidiary of Hanna Mining Co. (75%) and Republic Steel Corp. (25%).

The company has brought suit in Federal Court to annul the decree.

Meantime, Minister of Mines & Hydrocarbons Juan Perez Alfonzo says the government is considering development of the Cerro San Isidro deposit south of the Orinoco river through an arrangement to utilize the railroad and ore loading facilities of Orinoco Mining Co., US Steel subsidiary.

He adds that the government's intention is to grant no further iron ore mining concessions to private companies.

Legal action brought by Maria Luisa Ore Co. is the result of an official decree dated December 24, 1959, which extinguished the company's five concessions south of the Orinoco river on the ground that development had not commenced within the specified time limit.

The company argues that mining of some 12,000 tons of ore in the course of exploratory work which started in 1958 exceeds the minimum legal requirement for considering the deposit to be in development. The company says it is studying plans for a concentrating plant.

Maria Luisa Ore Co. acquired the concessions by purchase in 1952. The Minister of Mines & Hydrocarbons stated that at the time of the 1958 revolution in Venezuela, the company was also negotiating with the previous government for a concession on the Cerro San Isidro deposit.

Exploratory drilling at San Isidro by the Ministry indicates that ore deposits of 63% Fe content extend to depths as great as 720 ft, the Minister reported. Earlier, the Ministry's official bulletin listed reserves of San Isidro as 327-million metric tons "proven," and 2.4-billion metric tons "probable."

Construction of a 12 mile spur line would link the deposit to the Cerro Bolivar-Puerto Ordaz railroad of Orinoco Mining Co. The company has deep-water loading facilities at Puerto Ordaz.

The government last year declared a strip of territory 18 miles wide and some 300 miles long on the left bank of the Orinoco river a national iron ore reserve. The area on the right bank of the river, including Cerro San Isidro, had previously been set aside as a reserve.

Government income tax claims filed in late 1958 against Orinoco Mining and Iron Mines Co. of Venezuela, Bethlehem Steel subsidiary, are still pending.

Teamwork in Taconite

When your yearly mining requirements are for many millions of tons of one of the hardest rocks known to man, you need—and expect—long-life dependability from your loading equipment.

Ten Marion 151-M shovels are delivering just such dependability in this taconite operation on the Range.

There are a number of hidden benefits in the 151-M... benefits that pay off by keeping the cost per ton of output at a new low. Modern steels, for example, are used for all Marion mining machine front ends. This means reduced weight—increased payloads. Then too, these modern steels help reduce winter dipper stick failures... a perennial problem in the sub-freezing temperatures on the Range.

The odds are in favor of this tough Marion being the answer to your profit-production requirements. Find out by consulting a Marion mining specialist.

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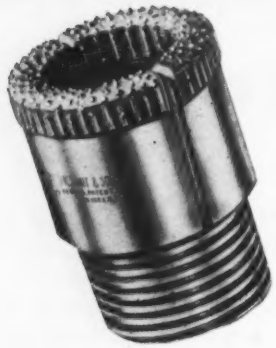

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Venezuela *(Continued)*

The claims are based on alleged under pricing of Venezuelan iron ore, most of which is sold to the companies' parent firms in the U.S.

The two companies operate under a 50-50 profit-split agreement with the government.

Preliminary figures of the Ministry of Mines & Hydrocarbons show that Venezuelan iron ore production last year was a record 17,403,545 metric tons, up 12% over 1958. Orinoco Mining produced 14,658,288 metric tons, and Iron Mines Co. 2,745,257 metric tons.

Exports totaled 16,915,877 metric tons, as follows (by country of destination):

	(metric tons)
United States	13,609,136
England	1,441,953
Germany	1,286,080
Italy	545,280
Japan	33,428

The Ministry forecasts another 12% increase in production this year to a total of 19.6-million metric tons. The Ministry projects a slower rate of increase in succeeding years to a total annual output of 25-million tons in 1965.

Broken Hill Will Tap Huge Iron Ore Find

AUSTRALIA's largest corporation, Broken Hill Pty. Ltd., plans to develop the huge iron ore deposits on Koolan Island, Yampi Sound, Western Australia.

The cost of the development will exceed $14-million and at least 2-million tons of ore will be recovered annually. Development will include the construction of a cargo wharf, access roads, airstrip, power station and a township for a population of about 600.

Schwartzwalder Mine Signs With Cotter Mill

ONE OF the highest-grade uranium ore producers in the U.S.—the Schwartzwalder mine in Colorado—has signed a five-year contract with Cotter Corp., Canon City, Colo., to deliver a minimum of 15,000 tons of 0.7% U_3O_8 a year to Cotter's Front Range processing mill. The contract was signed by the Schwartzwalder mine group and Denver-Golden which manages and owns 27% of the mine. Denver-Golden says that the mine has 78,000 tons of ore blocked out.

Bluewater's Stretch-Out

THE FIRST announced stretch-out of domestic uranium production has been signed into being—Anaconda's contract has been extended to Dec. 31, 1966, but 4-million lb of U_3O_8 scheduled for delivery between now and the end of 1962 have been rescheduled into the post-1962 period. Anaconda Co., which had

EUCLID'S GREATER DIMENSION

cuts hauling costs in mines and quarries

Model R-27 has rated payload of 54,000 lbs. and a heaped capacity of 26½ yds. . . . available with Cummins 335 h.p. and GM 336 h.p. engine . . . 4-speed Torqmatic Drive with converter lock-up and Torqmatic Brake . . . dual hydraulic booster steering . . . 18.00 x 25 tires on all wheels . . . rugged body with twin hoists . . . top speed with full payload, 34 mph.

Backed by better than 25 years of specialized experience in building off-highway earthmoving equipment exclusively, Euclid's modern rear-dump line incorporates advanced engineering that is a result of unmatched field experience. From the 10-ton Model R-10 to the big 55-ton "Euc" with two engines and a total of 672 h.p., Euclid Rear-Dumps meet today's requirements for big performance.

This greater dimension . . . in a wide range of capacities, in choice of engines, transmissions, tire sizes, and in type of hauler . . . in the parts and service facilities of Euclid's world-wide dealer organization, too . . . can mean lower hauling costs on mine and quarry work.

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A complete line of rear-dumps with payload capacities of 10, 15, 18, 22, 27, 40 and 55 tons . . . also semi-trailer models of 12, 22, 35 and 50-ton capacity.

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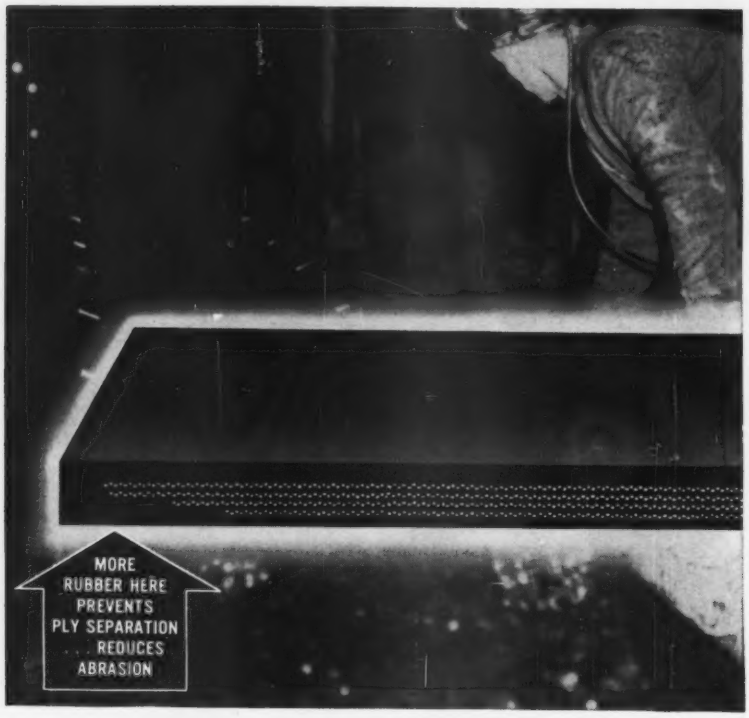

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gives Quaker Thermoid Conveyor Belting extra life where it counts

Unique "Coledge" construction puts more rubber *at the edges* where it's needed, prevents ply separation, makes a more flexible and wear resistant edge where abrasion is greatest. Punishment at the edges—especially the tough use dealt out in mining—can kill most conveyor belting in a fraction of the lifetime of Thermoid-Quaker belting.

Tests show Thermoid-Quaker "Coledge" construction lasts and lasts on the same jobs where other belting fails. "Coledge" construction is available on all grades of Thermoid-Quaker belting.

What's more, all Thermoid-Quaker conveyor belting is prestressed in manufacture, so that the belt is actually in compression when you get it—ready for the heaviest load without strain.

Examine Thermoid-Quaker Belting with the exclusive "Coledge" construction at your Thermoid distributor's, or write for further information to Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Streets, Philadelphia 24, Pa.

*Patent Applied For

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Bluewater *(Continued)*

voluntarily reduced output to 3,000 tpd mill feed, will continue at the 3,000-tpd rate on a six-day week basis. When the contract with the AEC expires, the company will have mined and milled less than half of the reserves developed prior to Nov. 24, 1958.

IN THE U.S.

ALASKA

Control of United Keno Hill Mines, Ltd., a silver, lead, zinc and cadmium producer in Alaska is to be acquired by Ventures, Ltd. of Toronto in a stock sale reported at $3.7-million.

Jott Mining Co. of Oklahoma made a barge shipment of uranium ore in early January from the Ross-Adams property on Bokan Mountain, Prince of Wales Island. The ore went to the Ford uranium mill near Spokane. Mining has ceased until spring.

CALIFORNIA

The San Francisco Bay Area will get its first fully integrated steel mill by the end of 1960, when Pacific States Steel Corp. will have completed a $7-million expansion program.

Pacific States Steel is located on a 100-acre site near Union City, in southern Alemeda County. Company recently completed a fourth open hearth furnace at the mill, and has a fifth under construction.

Pacific States Steel has also acquired iron ore mines in Nevada and coal mines in Colorado and Utah.

COLORADO

Zinc and lead refining at the Rico-Argentine Mining Co. mill at Rico was not interrupted by a fire Jan. 30 that caused about $230,000 damage.

Superintendent Orville Jahnke said the fire may have been started by a spark igniting a pile of pyrite in one of the bins. The principal damage was to the crusher plant and conveyor system.

President Sherman B. Hinckley said the mill had enough pyrite concentrates stored to continue production of sulphuric acid for several months.

Jahnke said there would be no layoff of personnel. Employees of the crushing unit will be kept busy on construction and cleanup work, he said.

Work has started on a tunnel to undercut the workings of metal mines at Lawson, two miles west of Idaho Springs.

The mines were worked extensively from the surface many years ago.

The first step is driving a 300-ft extension in the Princess of India tunnel owned by F. S. Saum. His plan is to drift under the workings of the American Sisters and Jo Reynolds mines which

Colorado (*Continued*)

were worked from tunnels several hundred feet up the side of Columbia Mountain.

The Princess of India tunnel goes into the base of the mountain. Saum said the present contract is for 300 ft of tunnel which will leave 1,000 ft or less before the tunnel heading would reach the ground under the workings.

Saum recently acquired the American Sisters group of claims which were sold at auction by a Denver company for the owners.

The American Sisters consists of several claims and was originally worked by a step-like series of seven tunnels driven into the side of Columbia Mountain, a 14,073-ft peak. The seven bores are about halfway between the base and summit of the mountain. The American Sisters has not been worked in about 50 years.

Saum also owns other mining property which he plans to cut at depth in the Princess of India tunnel or by laterals from it.

James A. Martin, Palisade, has extended uranium ore reserves substantially on the Black Momma, Corvusite and Liberty Bell claims near Gateway, on the Utah-Colorado line.

W. D. Nebeker, president, Croff Oil Co., owners of the claims leased to Mr. Martin, said the miner would be producing 500 tons monthly from the new finds by mid-summer.

The carnotite properties are not subjected to the usual restrictions as to ore reserve discovery date of Nov. 24, 1958. They fall within the special consideration being given Uravan Mineral Belt uranium producers by AEC in contracting for 1962-1966.

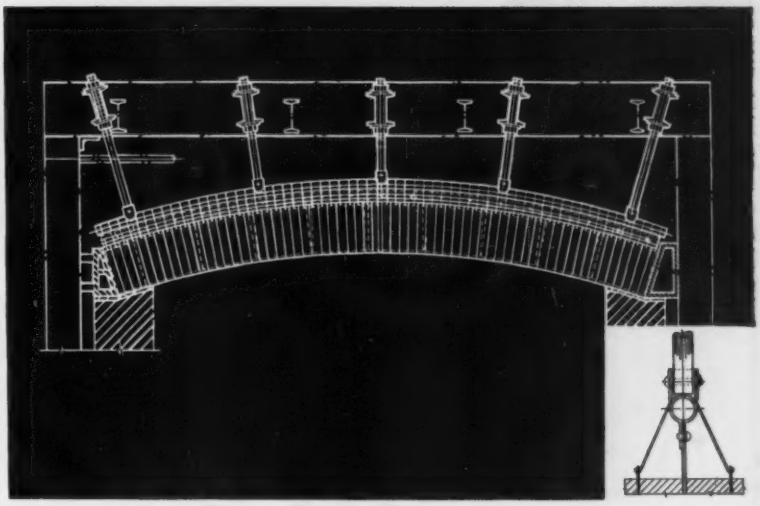
IDAHO

Idaho Cliffs, a subsidiary of Cleveland-Cliffs Iron Co. of Cleveland, has leased iron property near Mackay, in south central Idaho and is planning core drilling at the claims this spring or as soon as weather will permit. Geophysical and mapping work has already been done and warrants the core drilling, the operators claim.

Mining activities of Clearwater Mines, Inc., on Niagara creek in the Clearwater section of Shoshone County, 34 miles south of Superior, Mont., will be resumed in the spring or as soon as the road to the mine is free of snow, H. G. Loop, Spokane, manager, reports. The property consists of 12 patented and six unpatented claims first located in 1898 and taken over several years ago by Clearwater Mines, Inc.

Peter Mulhalland, who owns nine claims in the Elk City area of central Idaho, reports AEC has agreed to send engineers to the property to test the claims for uranium content this spring. He said construction of a washing plant will be started at the claims this spring.

The new silver-copper vein recently cut



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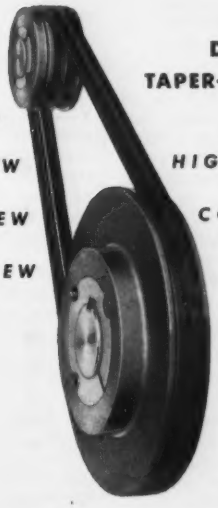

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NEW *SAVINGS IN COST*

COMPARISON, ILLUSTRATED ABOVE — 3 HP, 1750 RPM, 2.41 TO 1 RATIO

	BELTS		SHEAVES			CENTER DISTANCE	HP	WEIGHT (LBS.)	COST	
	Number	Size	O.D. Driver	O.D. Driven	Width				Per hp	Per Drive
BIG-GROOVE TAPER-LOCK DRIVE	3	A42	4.15"	8.95"	2½"	12.3"	4.62	24.7	$5.62	$25.98
DYNA-V TAPER-LOCK DRIVE	2	3V400	3.35"	8.00"	1⅜"	10.8"	5.0	18.0	$4.50	$22.50
% SAVING *Savings vary with different sized drives*			19%	10%	56%	12%	+	27%	19.9%	13.4%

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Dyna-V Sheaves decrease shaft overhang—increase bearing life. The new dimensional stability of Dyna-V Belts solves the problem of belt matching. Every belt carries its full share of the load.

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Idaho (*Continued*)

at the 3,000-level of the American Smelting & Refining Co.'s Galena mine near Wallace, has been followed for more than 200 ft and continues to look good, J. C. Kieffer, manager of Asarco's northwest mining department, reports. He said the vein still is narrow but that values are good enough to carry an 8-ft development drift. A high grade streak that has been exposed varies from 2 to 18 in. in width, he said.

A night shift has been added at the Jack Waite mine north of Wallace, which is under development under lease by Asarco. The additional shift is necessary to maintain normal production and drifting is continuing to the east on the 300-level there, J. C. Kieffer, manager of the northwest mining department of Asarco, said.

Perlite has been found in quantity in southeastern Idaho, near the town of Oneida, and may serve to bolster that area's sagging mining economy. Officers of United Perlite Corp., recently incorporated to produce the ore, say that plans are already under way for construction of a plant at Malad to turn the ore into a finished product and put it on the market. Marion J. Hess of Malad, president of the new company, is credited with discovery of the perlite deposits.

Edgar W. Oehrling and Arnold W. Mollenhauer have announced plans to develop a tungsten property 12 miles southeast of Coeur d'Alene, as soon as the price of tungsten shows improvement. They said good showings of tungsten ore were indicated at the old Bluebird mining property near Elk Mountain.

MINNESOTA

Oliver Iron Mining Div. is shipping 25 carloads of taconite nodules per day from its Extraca plant at the Rouchleau mine in Virginia to furnaces at Gary, Ind.

The January meeting of the Lake Superior Mines Safety Council was held in Hibbing. T. J. Baker, superintendent of the Webb and Whiteside mines, Snyder Mining Co., opened the meeting. Richard M. Paull of the M. A. Hanna Co., gave a paper on "From Cave Man to Space Man." Emmett Gilmore, assistant superintendent of Oliver's Monroe mine, talked on "Don't Be a Fall Guy," and J. A. Unger, Duluth, assistant supervisor of industrial relations for Pickands Mather & Co., had as his subject "Some Principles of Accident Prevention." After lunch there was a panel discussion on plant safety with Peter Crescenzo, Chisholm, superintendent of plant metallurgy for PM, moderator. Ronald Martinson, mechanical engineer with the M. A. Hanna Co.; Dick Costanzi, master mechanic, Snyder Mining Co.; Donald Kimbal, assistant to the general manager of metallurgy, Pacific Isle Mining Co.; Russell Abercrombie, concentrating plant foreman at the Hill-Annex mine of Jones & Laughlin Steel Corp.; Gordon Carlson, general beneficiation plant supervisor, PM&Co.; Kenneth Adams, general plant foreman, Canisteo mine of Cleveland-Cliffs Iron Co., and William Widstrand, assistant general plant foreman, Hull crushing plant, Oliver Iron Mining Division, took part in the discussion.

At the annual safety meeting of Reserve Mining Co.'s Silver Bay division at Silver Bay Jan. 29, R. J. Linney, executive vice-president, presented the Joseph A. Holmes safety award to James Reynolds, superintendent of the crushing and concentrating department. Mr. Linney said the department had established a record of over 1,201,000 man-hours between October 1955, and Dec. 31, 1958, without a lost time accident.

MONTANA

Zonolite Co. has completed addition of about 40% more storage space at its vermiculite mine near Libby. New silo-type bins have been constructed at the property. Ore from the mine is being transported by conveyor belt across the Kootenai River to a railroad loading area.

Bunker Hill Co. of Kellogg, Idaho, is pushing work at its Jack Pine phosphate lease near Elliston. Current exploration work consists of driving two tunnels along different portions of the phosphate bed and continuing a road-building project begun last summer. Bunker Hill is developing the property as a source of phosphate rock for the manufacture of phosphoric acid in the new multi-million dollar plant under construction at Kellogg.

Lester S. Harrison of Kellogg, attorney, reports Nancy Lee Mines, Inc., is currently engaged in extensive work on its holdings in the Superior area. The crew at the property has about 225 ft left to tunnel from the bottom of the mine shaft to reach a shoot of silver-lead ore indicated by diamond drilling from above.

NEVADA

Noble H. Getchell was elected president of Getchell Mines Inc. to fill the vacancy left by the death of George Wingfield. The election was held at a directors' meeting in January a short time after Wingfield's death. George Wingfield, Jr., was named to the board of directors, filling the vacancy left by Getchell's advancement. It was reported at the meeting that the company has undertaken the sinking of its three-compartment north shaft to the 800-ft level to explore and develop the gold sulphide ore zone at that horizon in the Getchell mine which is situated 50 miles northeast of Winnemucca in Humboldt County. The property had long been one of the state's leading tungsten producers prior to the shutdown early in 1958. The gold and tungsten orebodies are separate and in no way associated. Getchell said no target date has been set to start gold mining and milling operations, and that it is hoped by the management that tungsten production may be resumed at or near the time the company resumes gold operations.

The Bristol mine near Pioche in Lincoln County, which was a leading silver producer between 1956 and 1958 now has eight men employed. Exploration work is being carried on, and some ore is being mined and stockpiled awaiting resumption of operations by the Salt Lake Valley smelters. Most of the mine's 40-man crew were laid off when the copper strike closed the smelters in the fall of 1959. Byron S. Hardie is general manager of the company, and Arthur J. Bosch is superintendent.

A U.S. Navy helicopter came to the aid of Warren Meissner, well known Pershing County mining man, when he was injured in an accident at the Iron Hat mine during January. The property is situated in Dixie Valley, Churchill County, and when Meissner suffered facial abrasions and a dislocated shoulder aid was summoned from Fallon. The Naval Air Station there dispatched the helicopter which took the injured man to the hospital in Lovelock, 38 miles distant. The Iron Hat property employs 18 men who are producing iron ore from an open pit. Ernest Cox, of Lovelock, is president and general manager.

Great Lakes Carbon Corp. is maintaining steady production throughout the winter months at its diatomaceous earth treatment plant at Dicalite in northwestern Esmeralda County. John H. Graham is in charge of the mill, and Joseph U. Marinelli is quarry superintendent. The operation employs 43 men.

Camp facilities have been completed at the Mohawk mine west of Silver Peak in Esmeralda County, and work is continuing despite sub-zero weather at the property which lies at an elevation of 8,400 ft. A drift of 175 ft to by-pass the caved-in area has been completed, according to superintendent Thomas Kelly, and an incline shaft is being sunk from the 300-ft to the 400-ft level where an orebody is known to exist. Production is now from the 200-ft level and ore is stockpiled to await better weather when it can be trucked to the USM&M mill at Silver Peak. A total of 19 men are employed at the Mohawk property.

The Tonopah King mine employs 10 men who are producing good grade ore in steady supply from the 500-ft level of the property. Jesus Martinez is superintendent, and regular shipments to the USM&M mill are being made throughout the winter. Values in gold and silver are obtained from the property.

The Ohio mine at Gold Point is now operating three shifts and employing 22 men under direction of Harry David, superintendent. Workmen are now sinking from the 800-ft to 900-ft level to get under the known body of good ore, and steady shipments are being made to the USM&M mill.

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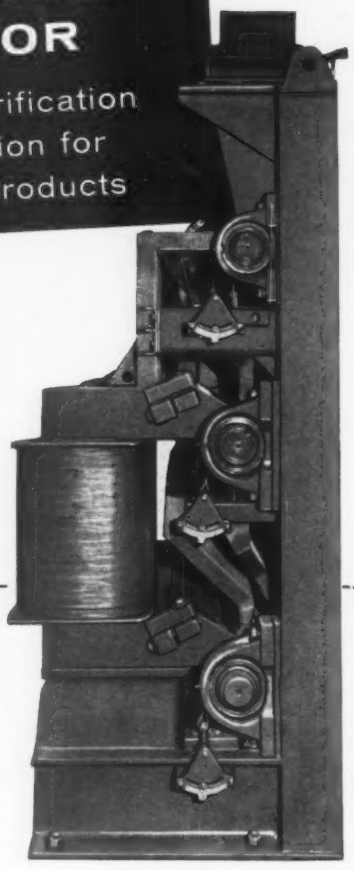

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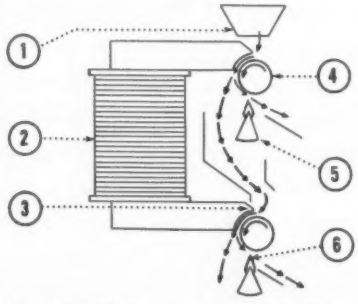

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TENNESSEE

A new iron ore mine has been established in Union County. The source of the ore is the Clinton sedimentary iron-ore beds, Silurian in age. Ore grade is averaging 52% Fe.

The ore is being stripped, loaded into trucks, and hauled to Rockwood, 50 miles away. There it is used by Tennessee Products and Chemical Co. in their No. 2 blast furnace which produces pig iron.

The 1959 production of zinc in Tennessee increased 47% to 87,000 tons, according to the U.S. Bureau of Mines preliminary report. Increased production was attributed to New Jersey Zinc Co.'s Flat Gap mine, Hancock County, and American Zinc Co.'s Young mine, Jefferson County. 1959 was the third successive year that Tennessee has led the nation in output of zinc.

New Jersey Zinc Co. is reported to be increasing production of ore at their Treadway mine by 50%. By the end of 1960, they plan to be producing at the rate of 3,000 tpd. This mine was first put into production in January 1959. By the end of the year, it was producing zinc ore at the rate of 2,000 tpd of ore.

Foote Mineral Co. reported expansion of its electrolytic manganese facilities in Knoxville with new capacity on stream since shortly after the first of the year. Additional cells, new rectifying equipment and other new processing equipment have increased the capacity of the company's Loraine plant by 30%.

UTAH

Bear Creek Mining Co.'s Tintic Unit venture continues to yield encouragement.

The affiliate of Kennecott Copper Corp. picked up a 157 ft core in drilling northward from the 1,050 ft level in a mineralized zone due west of the Burgin Shaft. About 25% of this core was recovered. It assayed 9 oz silver; 33% lead and 17.8% zinc.

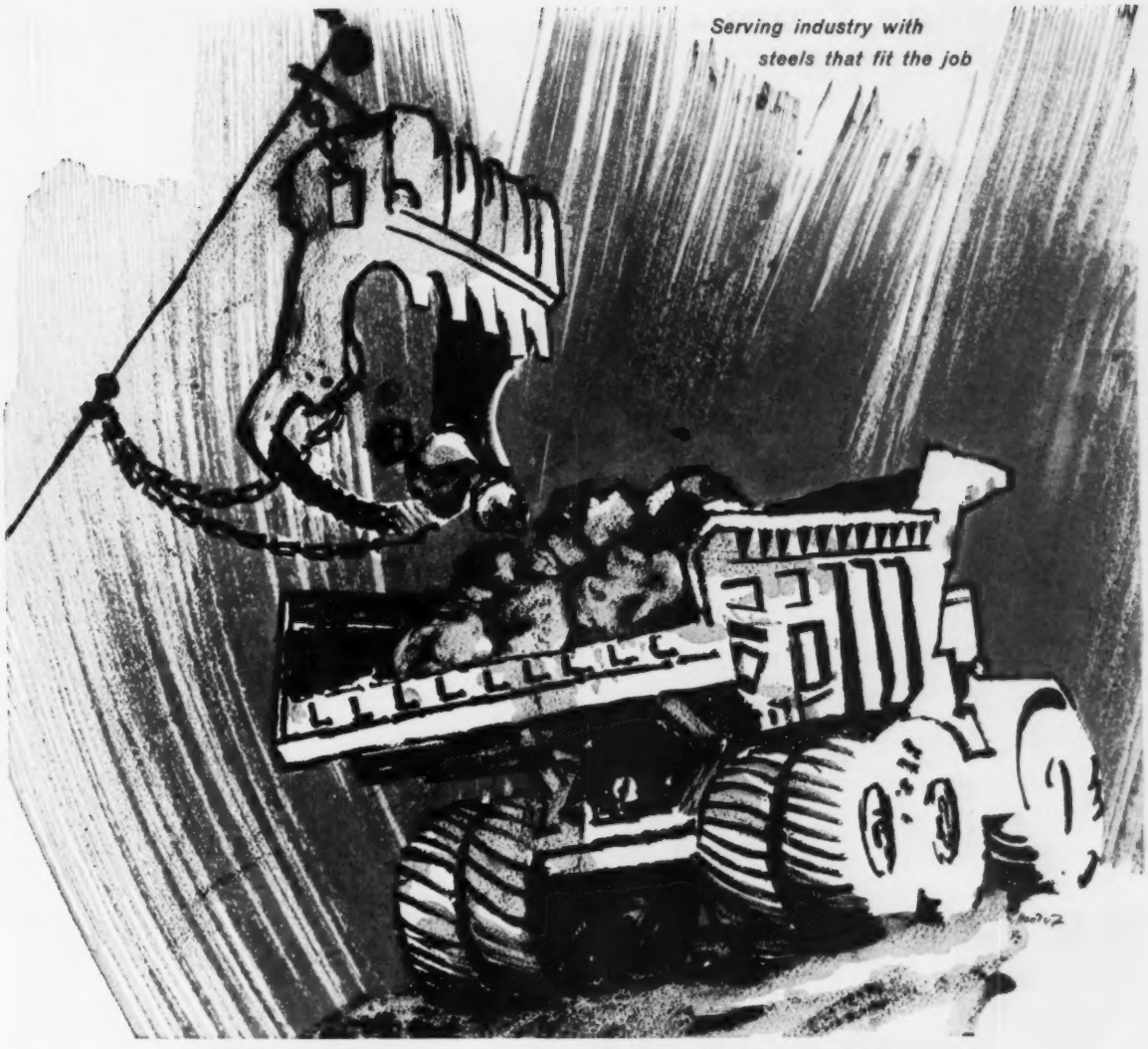
In another exploration area, where drifting and cross-cutting is being carried out, a "full face" (6x8) of galena ore was cut southwest of the Burgin.

Machinery Center, Inc., Salt Lake City, has bought the 1,000 tpd Blackbird cobalt-copper mill of the Calera Mining Co., Cobalt, Idaho. Calera is a wholly-owned subsidiary of Howe Sound Co.

The mill is being leased back to Calera for several months while that firm completes run of copper, surface values already mined. It will then be disposed of by the Salt Lake company.

WASHINGTON

Ore production has been started on a new lower level at the Grandview mine near Metaline Falls, according to officials



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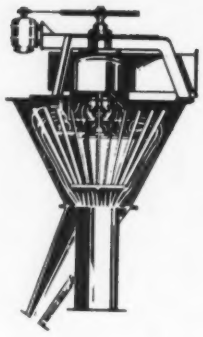

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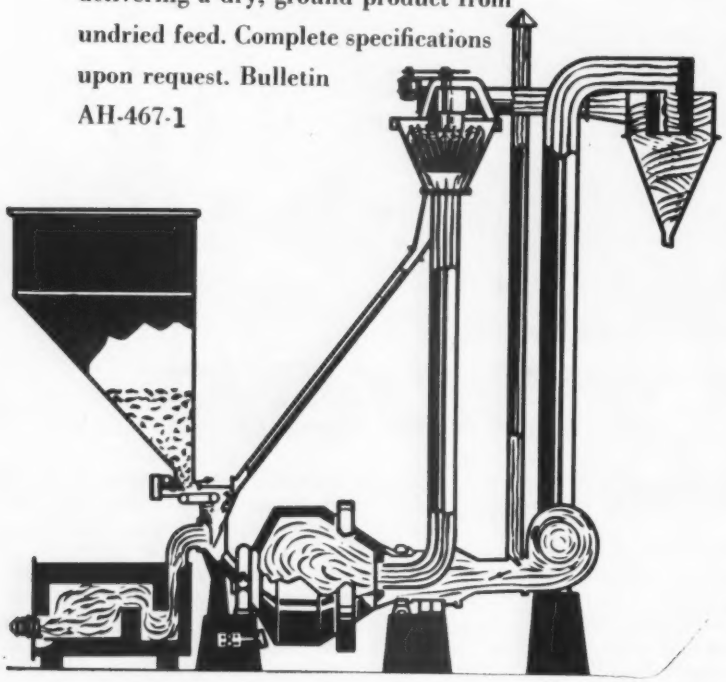

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Washington (*Continued*)

of American Zinc, Lead and Smelting Co. The new 650-ft level was opened by an inclined shaft which was put down at a point 3,000 ft from the bottom of the main operating shaft.

Ore at the property is now being mined from three levels and production is running at about 19,000 tons a month.

Paymaster Mines, Inc., Pateros, has completed construction of a 50-tpd mill at the site of a gold-silver-copper tungsten property in the Hunter Mountain area northwest of Pateros. It is near the site of an extensive mining development started in the early 1900's and later discontinued.

Operations were to resume last month at the Kulzer iron mine in Stevens County, near Valley. The property was shut down in January because of freezing weather.

The mine, which was Washington state's only iron producing property in 1959, produced about 5,000 tons of hematite in open pit operations and the product was shipped to the Ideal Cement Co. plant at Spokane.

Utahcan, Inc., Spokane, reported that a crew is now sinking a shaft on a vein of high grade lead-silver ore at the firm's mining property near Ione. The vein was discovered while bulldozing a road several months ago. It has been widened from 15 in. to about 2 ft in going down 8 ft for a shaft collar.

Officials said that concentrating of milling grade ore in the company's new mill, completed last year, will be resumed in the spring.

WISCONSIN

New Jersey Zinc Co. has confirmed the presence of zinc sulphides at a drilling seven miles southeast of Platteville.

The firm has been prospecting in the area for some years without opening a mine, although its negotiator, Lloyd Newman of New Diggings, has obtained a number of leases with owners of land on which New Jersey has done test drilling.

John Hague, head of the New Jersey operations in the area, said he did not anticipate that production at the ore discovery would be above that of the Francis Piquette Mine near Tennyson, which employs 30 men and produces about 500 tons of zinc concentrate a month.

With the reopening of several mines in the area in recent months, production of raw lead and zinc ore was reported at about 4,300 tpd, compared with some 3,000 tons after prices dropped several years ago. If New Jersey Zinc developed its project and produced 400 tpd of raw ore, production in the district, which includes Galena, Ill., and Dubuque, Iowa, areas, would be higher than the World War II high of 4,500 tpd, according to W. A. Broughton, chairman of the geology department at Platteville State College.

Tall in the Saddle

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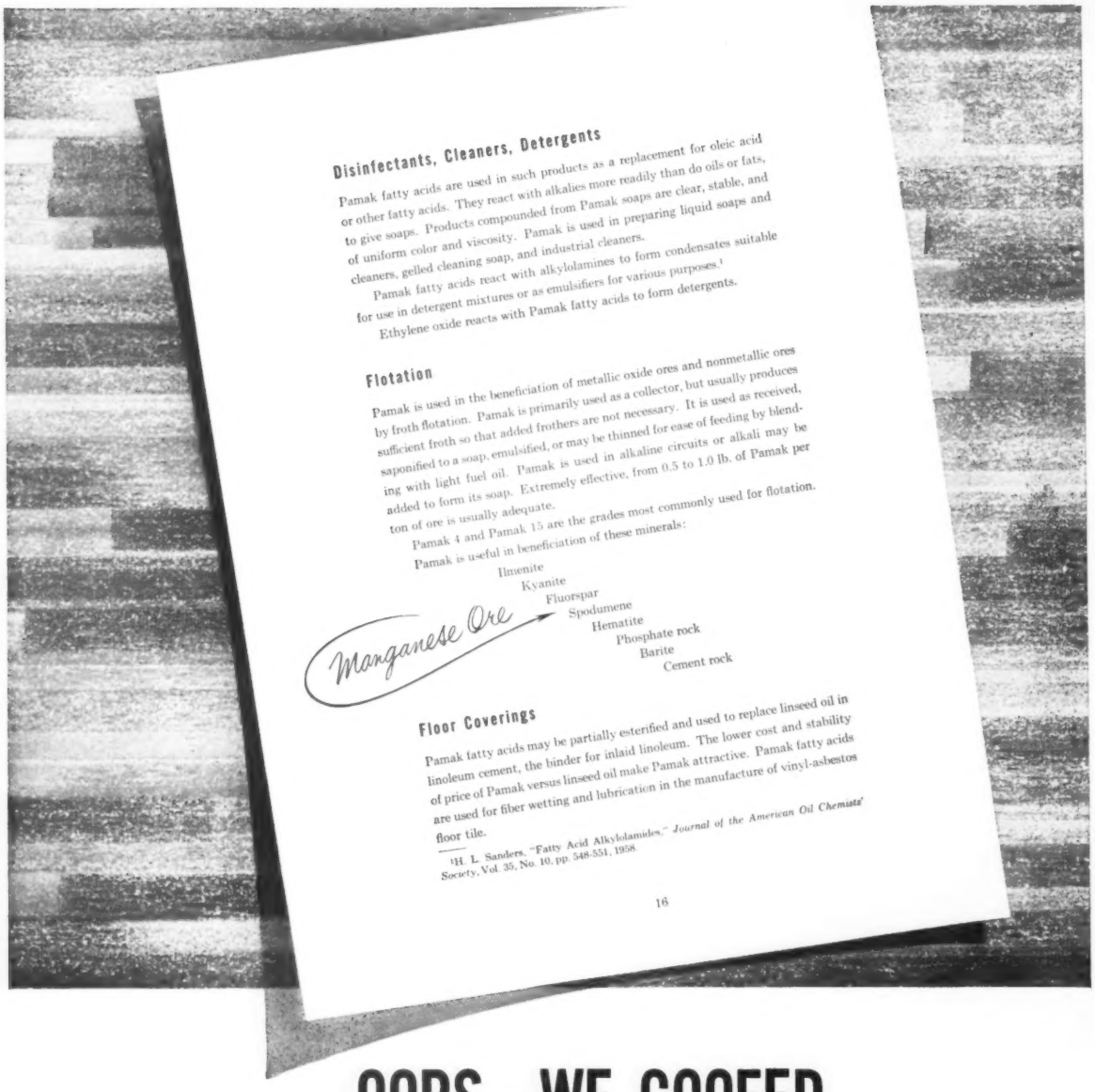
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Ethylene oxide reacts with Pamak fatty acids to form detergents.
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Pamak is used in the beneficiation of metallic oxide ores and nonmetallic ores by froth flotation. Pamak is primarily used as a collector, but usually produces sufficient froth so that added frothers are not necessary. It is used as received, saponified to a soap, emulsified, or may be thinned for ease of feeding by blending with light fuel oil. Pamak is used in alkaline circuits or alkali may be added to form its soap. Extremely effective, from 0.5 to 1.0 lb. of Pamak per ton of ore is usually adequate.
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[1]H. L. Sanders, "Fatty Acid Alkylolamides," Journal of the American Oil Chemists' Society, Vol. 35, No. 10, pp. 548-551, 1958.
16

OOPS—WE GOOFED

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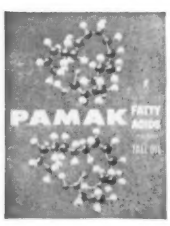

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Wisconsin (*Continued*)

Bear Creek Mining Co. is drilling a third test hole in Douglas County, in the Brule area. Two other holes have been drilled to 3200 and 1490 ft, but no information has been given out as to the findings. Bear Creek Co. has permission to do exploration drilling on about 105,000 acres of Douglas County owned property.

There is still rugged individualism of the frontier type in southwestern Wisconsin's lead and zinc mining area. Joe Grimes, a Platteville resident with a mining education, said he had been prospecting and was ready to "sink an incline" at Toadville, about halfway between Platteville and the Piquette mine.

Grimes planned to employ two men and to contract for trucking his zinc ore to Francis Piquette's mill, which turns out about 500 tons of zinc concentrate from its own mine every month.

"If I can bring out 50 tpd we'll make it pay," Grimes said. "If we don't, all that is lost is my own money."

WYOMING

Utah Mining Corp. started production of yellow cake uranium ore from its new mine in the Shirley Basin of Carbon County, late in January.

Construction of the mine was completed late in January, according to Morton Pratt, Utah Mining Corp. superintendent. Shafts were drilled last spring after the Atomic Energy Commission allocated 150 tpd of ore for the new area. The mine will produce 100 tpd.

Utah Mining Corp. also has extensive mining operations in the Gas Hills area.

Tri-State Uranium has purchased six uranium claims on Copper Mountain from Geneva Uranium. The claims were originally staked by C. R. Shelley of Shoshoni.

Radorock Resources, Inc. and Federal Uranium Corp., both of which divorced four years ago, are now proposing merger.

Directors of the companies, meeting at Salt Lake City, approved resolution proposing the merger on share-for-share-basis at some future special stockholders sessions of the firms.

Radorock and Federal have a number of joint ventures, including mine and mill interests in Wyoming's Gas Hills uranium district, and stock ownership in Dynamic Metals Corp. and Beryllium Resources, Inc., two beryllium firms.

At the meeting proposing merger, it also was announced that Radorock exchanged a 7½% royalty on the Radon-uranium mine, San Juan County, for half interest in the Conjecture silver prospect of Federal's in Idaho's Couer d'Alene district.

Federal is currently engaged in ore reserve determination at Conjecture as a prelude to fixing mill requirements.

The merger announcement was made by Nels W. Stalheim, Radorock presi-

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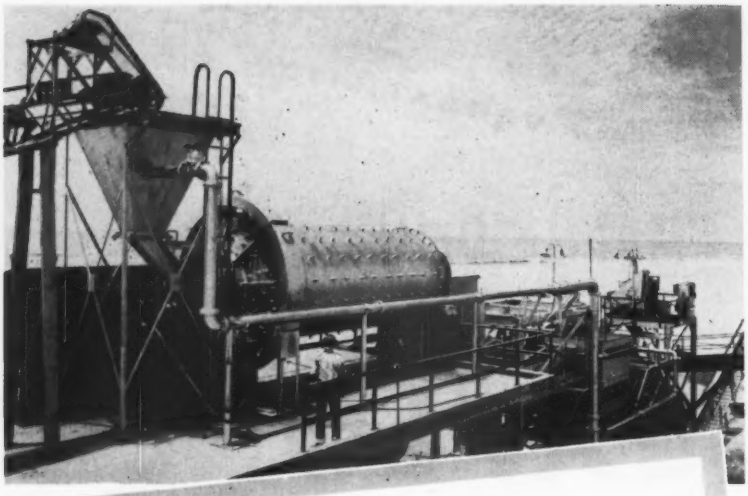

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Wyoming (*Continued*)

dent and Ralph W. Neyman, head of Federal, both of Salt Lake City. They urged stockholder approval, citing the immediate Federal tax savings that could be effected as well as other economies.

A contract to move 2,800,000 yards of overburden in the Gas Hills has been let by Federal Uranium Partners to Sharrock and Purcell, Casper contractors.

The large tonnage will be moved from a new mine on the Clyde group of claims in the west Gas Hills. The mine will be located northwest of Western Nuclear Corp.'s Loma mine.

Work is expected to begin on the Clyde "A" pit stripping in the very near future. The Clyde contract is the third mine to be opened by Federal-Radorock-Gas Hills Partners in the Gas Hills.

Federal opened the Sagebrush "D" mine first. Original stripping was performed by Ryan Construction, and a second phase was completed last fall by Gilpatrick Construction. It is in the central Gas Hills near the Federal unit.

The first uranium ore shipment from the Green Mountain Uranium Corp. property in Fremont County, was held in early February.

Ceremonies were held at the Western Nuclear mill at Jeffrey City to receive the first ore shipment. Governor Joe Hickey attended the ceremony.

The Green Mountain mine is about eight miles south of Jeffrey City. Green Mountain was formed several years ago when Wyoming Uranium Corp. was merged with Phelps Dodge interests. Exploratory drilling and underground tunneling have been conducted on the property for the past five years.

IN CANADA

LABRADOR

Premier Joseph Smallwood of Newfoundland has announced that British Newfoundland Corp. will build a 120,000 hp hydro plant near Hamilton Falls. Surveys have been completed and preliminary work in the field will start in February. The project, including transmission lines, is scheduled for completion in the summer of 1962.

Iron Ore Company of Canada Ltd. and Wabush Iron Co. Ltd. have agreed to buy the power for use mainly in the new iron mines opening up in the Wabush Lake area of Labrador, some 110 miles from the power site. (See E&MJ, March 1959, p. 116.)

ONTARIO

Falconbridge Nickel Mines is now operating at its new capacity rate of more than 30,000 tons of nickel annually. The expansion program, which has been

The Company that cares enough to give you the best!

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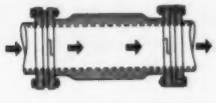
PINCH VALVES

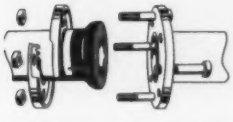
RUBBER, NEOPRENE
for Corrosion and Abrasion

- 1" to 14" inside diameter.
- Pressures to 150 psi.
- Temperatures to 200° F.
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.

- Cannot leak or stick.
- No working parts in contact with pulp or liquid; no packing glands.



- Unobstructed flow eliminates high friction loss.
- Remote control available.
- Can be equipped for automatic regulation.



- Split flanges and patented Flex Seal ends assure perfect seal.
- Closing mechanisms... manual handwheel; handwheel with chain and sprocket reduction unit; electric worm gear motor reducer; chain operated torque arm reducer; hydraulic; air-hydraulic.

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Manufacturing Division

MINE AND SMELTER SUPPLY CO.

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OFFICES AND AGENTS IN PRINCIPAL CITIES

Ontario (*Continued*)

in progress for the past six years, was aimed at eventual output of 27,500 tons.

Temagami Mining Co. has increased ore reserves by 10% since the end of the fiscal year, June 30, 1959, at its copper producing property at Lake Temagami. Reserves on June 30 were estimated at 106,075 tons grading 9.9% copper. The company is shipping concentrate to the Noranda smelter at a rate of about a carload per day.

Preston East Dome is concentrating development work on the former Midcamp Mines' property adjoining its producing gold mine in the Porcupine area. The main oreshoot as delimited by work from Preston and Paymaster during the past 8-9 years, extends from above the 12 level to around the 21 horizon and is estimated to contain over 300,000 tons grading 0.26 oz gold per ton. Drives are going out on the 12, 15, and 18 horizons from Preston.

New Dickenson Mines has run into a new high grade orebody at depth at its producing gold mine in the Red Lake area. The new vein has been opened for a length of more than 240 ft with grade averaging about 1.70 oz gold per ton (cut grade) across drift of 6.2 ft.

Caland Ore Co., wholly-owned subsidiary of Inland Steel Co., Chicago, Ill., is prepared to start production from its Steep Rock iron property as soon as the 1960 shipping season opens. Target for the year is 750,000 tons. Initial production will be drawn from the Lime Point open pit. In the meantime underground development is going ahead at the company's Falls Point mine, which is scheduled for maximum production of 1.5-million tons annually.

Consolidated Denison Mines turned out a record $49.4-million worth of uranium concentrates in 1959. Production amounted to 4,916,108 lb of uranium oxide, compared with 4,239,761 lb in 1958. Over 2-million tons of ore was hoisted during the year. Development work prepared not only the tonnage moved during the year but added a further 2-million tons of positive ore.

Geco Mines is preparing to open the next phase of the development program at its copper-zinc-silver-gold producer in the Manitouwadge area. The No. 3 internal shaft was completed recently to depth of 2,565 ft and six new levels are to be driven the ore zone this year.

Canadian Dyno Mines has concluded agreement with Gunnar Mines, whereby the latter will make deliveries to Eldorado totaling 2,538,255 lb uranium oxide by March 31, 1963, against Canadian Dyno's contract. Canadian Dyno is to continue production from its Bancroft area mine until the end of this June, when operations will be closed down. To that time, Dyno is expected to deliver a further 120,400 lb uranium oxide not covered by the Gunnar agreement.

Violamac Mines expects to bring its

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For air, water and ventilating lines, it will pay you to get the facts on NAYLOR pipe as well as on NAYLOR Wedgelock couplings. Just write for Bulletin No. 59.

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Holds Fast Under Normal Loads

Bethlehem's Yieldable Arch is just the kind of support you need in squeezing pressures. Each set of arches works on a principle of sliding joints, which are formed by the lapping of one U-shaped segmental steel section over another as shown in the photograph. Husky U-bolt clamps are installed in pairs over the lapped joints, and drawn up tightly enough to hold fast under normal loads. As pressures bear down, however, the set yields, a little at a time.

Adds to Mine Safety

As the Yieldable Arch "gives," the stress is transferred to the surrounding material. When equilibrium is reached the Yieldable Arch stands pat, its structural integrity maintained and mine safety preserved. That is why you will hear it said that the yieldability of the Arch is more important than physical strength.

There is much more you will want to know about the Yieldable Arch. Its ease of installation, for example, and its high degree of recoverability. You'll be interested, too, in knowing that many Yieldable Arch installations have paid for themselves in a matter of months! A Bethlehem engineer will be glad to discuss the full story in terms of your own special conditions. Just give us a call.

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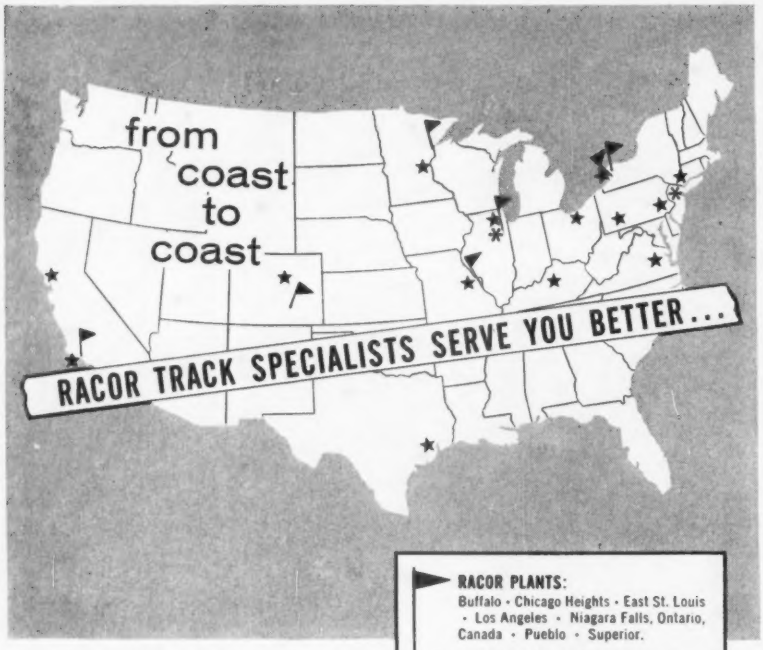
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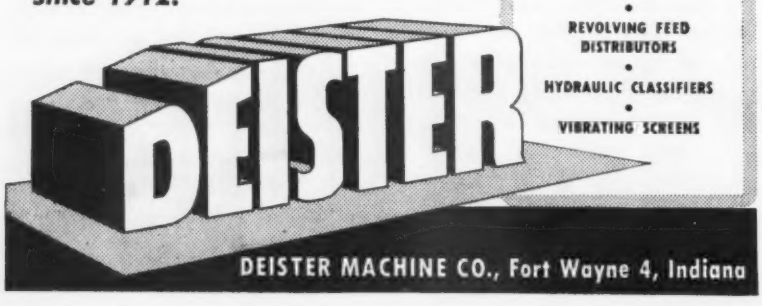


Ontario (*Continued*)

Kam-Kotia copper open pit property into production in August of this year. A 750-tpd capacity mill has been purchased, and a 1,000-tpd crusher is being installed. It is estimated that there is about 1.5-million tons of 1.8% copper already in sight.

Cochenour Willams Gold Mines' west zone, which has been designated as being "virtually a brand new mine," at the gold producing Red Lake area property, is continuing to show increasing grade and tonnage at depth. Development ore from the 1,425-ft level, the deepest yet opened, is grading above 1 oz gold per ton, while diamond drilling below the level down to the 1,550-ft horizon has returned ore intersections running into ounces.

Rio Tinto controlled uranium producing companies, including Algom, Northspan, Pronto, and Milliken Lake, all in the Elliot Lake area, intend to stretch out the remainder of their contracts. Meetings of shareholders of the individual companies are being called to consider the proposal. Present contracts of the companies call for delivery of some 17,000 tons of uranium oxide. The stretch-out would allow continuing production until 1966.

QUEBEC

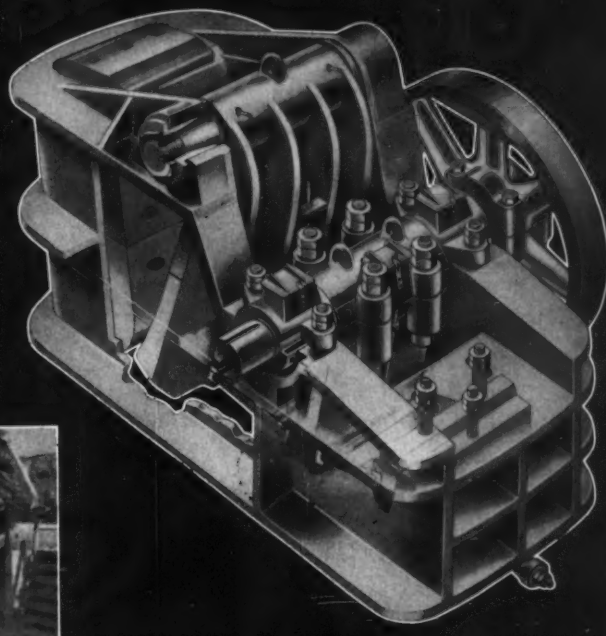
New Calumet Mines has run into a brand new ore zone in drilling below the 1200-ft level at its zinc-lead producer on Calumet Island, some 60 miles northwest of Ottawa. The new find is the best grade that the mine has encountered in some years. True width is given as 28 ft with grade of 15% zinc, 6% lead, 12 oz silver and 0.02 oz gold per ton. The new ore is within driving distance of the lower levels and "will be investigated as soon as possible." During the past year ore reserves have been increased substantially and at the end of the latest fiscal year, Sept. 30, 1959, totaled 225,925 tons against 151,897 tons a year earlier. Grade was maintained and averaged 7.99% zinc, 2% lead, 0.019 oz gold and 4.45 oz silver per ton.

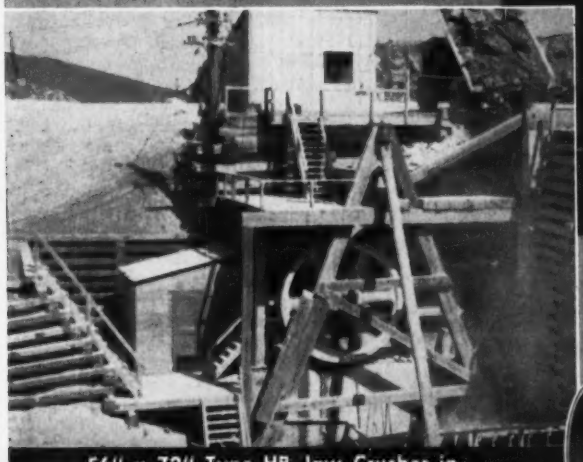
Murray Mining Corp. is lining up a $1-million program for its Ungava asbestos project this year. The program will include some 20,000 to 30,000 ft of diamond drilling, the driving of an adit across the ore zone, further geophysical work, road building, selection of townsite and harbor, and detailed economic surveys. Last year's work indicated 3.5-million tons grading $20 per ton to depth of 200 ft plus an additional inferred 3.5-million tons of similar grade to 400-ft depth.

Normanville Mining Co., wholly-owned subsidiary of Jones & Laughlin Steel Corp., is drawing up plans for diamond drilling after spring breakup on its iron properties in the Mount Wright area, about 185 miles north of Seven Islands. Most of the drilling will be on claims

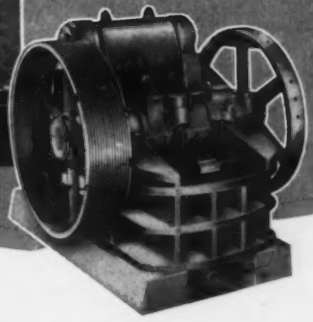
Traylor-made H & HB Jaw Crushers

Cutaway view below shows the advanced design of Traylor type HB Jaw Crusher.





56" x 72" Type HB Jaw Crusher installed in quarry of a steel mill.



One of the many important features of the Traylor HB Jaw Crusher is the Traylor developed curved jaw plates employing the principal of the famous curved setting which have proved so successful in Traylor crushing machinery. The forged steel swing jaw shaft and the patented swing shaft suspension are two more of the features built into Traylor Jaw Crushers. For more information, write for Traylor Bulletin No. 5105.

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Units available from 3,000 lb. to 15 ton capacity. Write for specifications and literature. See your Dealer.

GETMAN BROTHERS

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Quebec *(Continued)*

not yet been tested to any great extent. Plans also call for metallurgical testing on known deposits and geological mapping and engineering studies. The main deposits are located at Bloom Lake. Over-all tonnage is estimated at roughly 1-billion tons of beneficiating iron containing an estimated 335-million tons of iron concentrate.

Jack Waite Mining Co. has made an agreement to purchase a 3,000-acre copper prospect from Simone Iron Corp., a wholly-owned subsidiary of Canadian Javelin Ltd. The property is located some 40 miles west of Wabush Lake in the Mount Wright area. An exploration program calling for expenditure of about $100,000 to be provided 60% by Canadian Javelin and 40% by Jack Waite, is scheduled to start within the next month.

Molybdenite Corporation of Canada has upped mill rate at its molybdenite producing property in LaCorne Twp. from 618 tpd in 1958 to 664 tons during the past year. Proven ore reserves have also been increased. Blocked reserves at Sept. 30, 1959, totalled 240,889 tons averaging 0.39% MoS_2, compared with 205,558 tons grading 0.41% at Dec. 31, 1958. Probable ore reserves were estimated at 600,000 tons. Exploration on two new levels at 875 and 1,000-ft depth is now in progress.

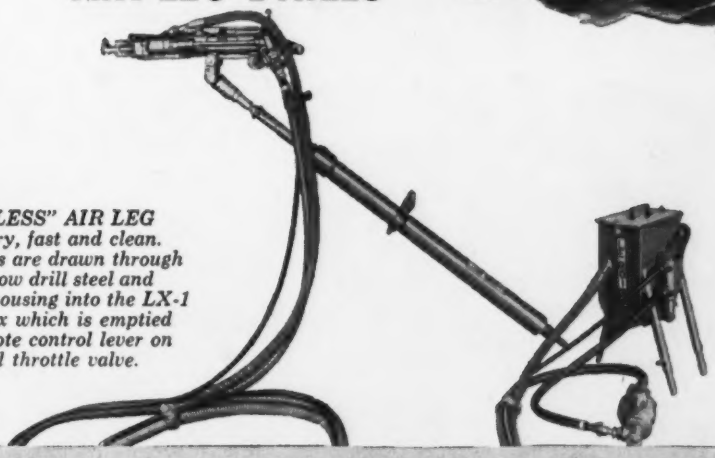
A new theory of copper deposition has sparked a wave of new property acquisition in the Noranda-Rouyn area. The revival of exploration activity stems from the theory that a dome structure governs known copper deposits. The latter occur along or close to the margins of a ring-shaped belt of acid volcanics extending through Dufresnoy, Duprat, Montbray, Dasserat, Beauchastel and Rouyn Twps. Present activity is being concentrated in Montbray and Duprat Twps. Most recent entries into the area have been Southwest Potash Corp., an American Metal Climax subsidiary, Kerr-Addison Gold Mines and Noranda Mines on a 50-50 basis, and Chesterville Mines.

Drilling at Lamaque Gold Mines has given indications of an entirely new and important orebody about a mile southeast of the mine workings on the company's gold producing property at Val d'Or. The discovery was made in an exploratory hole with main intersection returning 97.6 ft averaging 0.35 oz gold per ton. This section included a length of 4.4 ft assaying 2.536 oz and 54.3 ft averaging 0.543 oz. The discovery is located in an anomaly outlined by magnetometer survey covering an area of approximately 350 ft east-west and 200 ft north-south. Drilling is being continued.

Diamond drilling by Falconbridge Nickel Mines on the Marchant Mines' nickel property in LaMotte Twp. is tending to confirm and add to previous ore estimates. In previous work indicated tonnage was calculated at 352,961 tons averaging 3.95% nickel to 550-ft depth. Present drilling has intersected values down to depth of 800 ft, the deepest drilling yet done.

NO STUCK STEELS

WITH THE NEW LE ROI DUSTLESS AIR LEG DRILLS



NEW "DUSTLESS" AIR LEG drills dry, fast and clean. Cuttings are drawn through the hollow drill steel and chuck housing into the LX-1 dust box which is emptied by remote control lever on the drill throttle valve.

Steels never stick when they're on the business end of the *new* Le Roi LLV Dust-Collecting Air Leg Drill. The dustless drill melts its way through the hardest rock — piles up more drilling footage with a lower dust count than was ever possible with wet drilling.

Dry, dustless drilling permits continuous ore sampling — saves every speck of precious ore. It eliminates the need and expense of water — does away with wet, dangerous conditions; sinking pillars; lost holes; water and muck haulage.

The LLV collects dust through the drill steel and exhausts it through the chuck housing — *not the machine!* It's ideal for mining or tunneling in hard rock — saves tools and operators.

Ask your Le Roi distributor for a demonstration. Or for more information, write to the Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wis.

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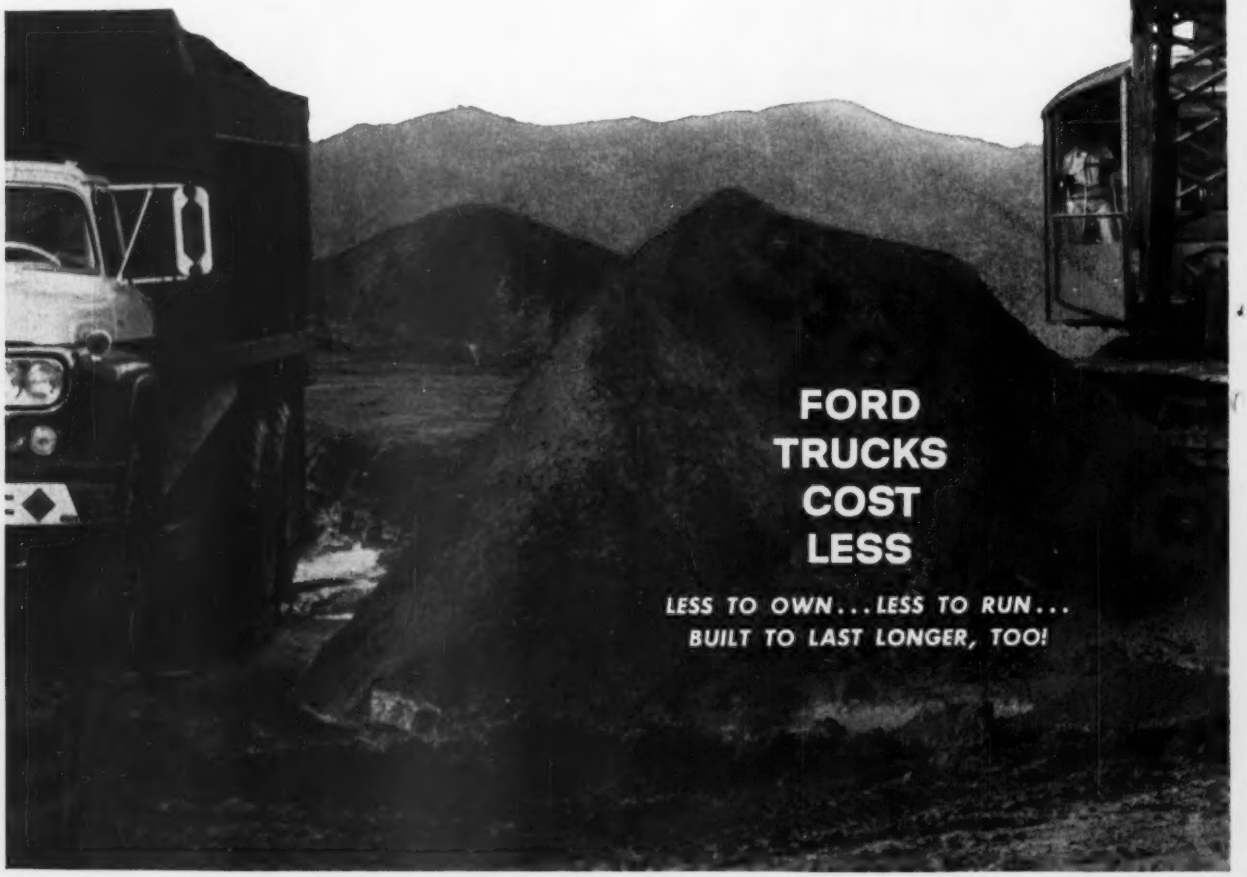
"We traded the F-900 in on two '59 Ford Tandems in order to meet increased production requirements and stay within axle load limits. I drive the T-850 myself and it's the smoothest ten-wheeler I've ever been in. That '477' engine has what it takes to make the grades in style and it hasn't missed a trip yet!"



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Dynamometer Tests of Ford's submerged-type electric fuel pump showed no power loss at temperatures up to 200° F, vs. 9% loss with mechanical fuel pump under the same conditions.

Shaker Table Tests plus constant exposure to oil, water and heat proved Ford's 1960 wiring harness to be three times longer lived than the 1959 harness.

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Certified results of these and other tests conducted by America's leading automotive research organization, plus a comparison of manufacturers' suggested list prices, are now available at your Ford Dealer's. Take him up on his offer to check the records . . . see and drive the new Ford Trucks . . . *you'll save for sure!*

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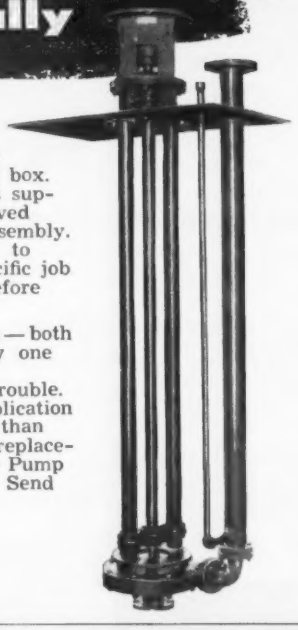

This Nagle 1½" type YWS-CS centrifugal pump, one of several built for DuPont, handles molten unfiltered sulfur. Discharge line is steam jacketed. There is no stuffing box. Bearing in contact with the hot material is supported in a split yoke which can be removed and replaced without major shop disassembly. Impeller and casing are of special alloy to resist heat, and abrasion. Built to do a specific job for a long period of time. Pump is shown before installation of motor.

There are many types of Nagle Pumps — both horizontal and vertical shaft units — every one designed and constructed for use where ordinary pumps give trouble. If yours is a tough application you're doubtless more than paying (in service and replacement parts) for a Nagle Pump — so why not have it? Send for literature.

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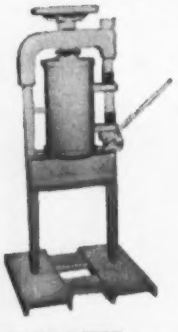

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MANITOBA

Discovery of a mineral occurrence which may prove to be a hitherto unidentified source of cesium is reported from the Montgary mine operations of Chemalloy Minerals, Ltd., at Bernice Lake.

The new ore, now being analyzed, was encountered in the final stage of cutting through to the Montgary mine's pollucite ore deposit 300 ft under lake bottom.

SASKATCHEWAN

Tests of the water-laden Blairmore formation, from coring, indicate that the Unity potash shaft of Continental Potash Corp., Ltd., can be extended through and beyond that difficult stratum.

The shaft was sunk to the top of the Blairmore in 1958 when work ceased because of problems encountered in controlling water flow.

F. S. Welters, company president, now reports that the results of coring and testing of the Blairmore "proved better than expected."

He said sinking through the formation is not expected to present any insurmountable problems.

Terms of the company's permit from the Saskatchewan government obligate it to spend $410,000 in the three years to June 1960 on exploration and development on the potash property in the west-central sector of the province.

So far, $343,396 had been expended to May 1959 and $80,000 since that date.

BRITISH COLUMBIA

Increased interest of Japanese manufacturers and business men in the purchase of ores and concentrates, and the success of oil and gas exploration in northeastern B.C., Yukon, and Northwest Territories were the highlights of the year, Christopher Riley told members of the B.C. and Yukon Chamber of Mines at the annual meeting in Vancouver.

Dr. Riley, consulting geologist, was reelected president of the Chamber and in his annual report he indicated a brightening future for the B.C. mining industry.

Vice-presidents are R. E. Legg, consulting mining engineer, and Gavin Dirom, American Smelting and Refining Co.

Honorary president is B.C. Mines Minister Kenneth Kiernan, and Walter B. Boucher, honorary treasurer.

John Davis, B.C. Power Corp. planning and research director and former chief economist to the Gordon Commission on Canada's economic prospects, said Canada can easily afford to build a uranium refining plant according to cost figures just released in the U.S.

The first-stage plant would cost about $200-million, and if built in B.C. would be just in time to absorb a large block of power from either the Columbia or the Peace River hydro projects.

The Atomic Energy Commission has opposed a uranium enrichment plant for

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B. C. *(Continued)*

Canada, claiming it is beyond its resources, Davis said; and it is argued that because Canada uses the heavy water system in its nuclear power program, only raw uranium is needed.

This "inward looking" approach will spell doom for the uranium mining industry, said Davis.

Canada's uranium exploration program has been slowed down by dwindling markets, and Britain and other European countries which do not have power resources to refine Canada's raw uranium are compelled to buy enriched material from the U.S.

Davis said the argument of heavy water versus enriched uranium does not affect the need for a refining plant, and one could be built beside the power source and the cost of transmission lines would be saved. Ore could be flown to the plant, as the amount needed would be far less than other supplies needed by the plant workers from day to day.

The Gold Mining Assistance Act will be extended another three years at current rates. Under the act, due to expire at the end of 1960, 40-50 gold-producing mines in Canada get some $12-million. Assistance is available to those mines which have a production cost exceeding $26.50 per oz and who make application. A spokesman for a B.C. gold mining company said the industry had anticipated the assistance would be renewed. Without it many gold mines would be closed.

Cassiar Asbestos Corp. reported completion of its expansion of mill capacity at the annual meeting in Toronto. F. M. Connell, president, said the mill is now capable of treating 1,500 tpd against former rate of 1,000 tpd and test runs at full tonnage have been satisfactory.

New ore developments on the 5,700-ft level require an increased rate of stripping to ensure ample ore is stripped and available to meet future requirements. The company will maintain an active exploration program in northern B.C. and the Yukon and expects to spend $1-million during the current year on mine development.

Consolidated Standard Mines plans to develop its molybdenite discovery, optioned on the Alice Arm area and the Jordan lead-zinc prospect near Revelstoke this year. Consolidated Standard is successor to American Standard Mines Ltd. Name change was approved at the annual meeting. Bralorne Pioneer Mines Ltd. is the largest shareholder. The company has transferred its option on the Jordan River property to a new subsidiary, Jordan Mines Ltd.

Representatives of the Sumitomo Metal Mining Co. Ltd. of Tokyo, led by the firm's senior managing director, Kenjiro Kawakami, arrived in Vancouver to talk business with leading mining groups. The Japanese want to buy iron, copper, nickel, lead, antimony, and cobalt. Discussions have already been held with Bethlehem Copper and it is rumored Japanese interests might invest $5-million to bring the Highland Valley property into production. This could mean a mill will be built on the property, and ore be concentrated and shipped to Japan for smelting and manufacture over a 10-year period.

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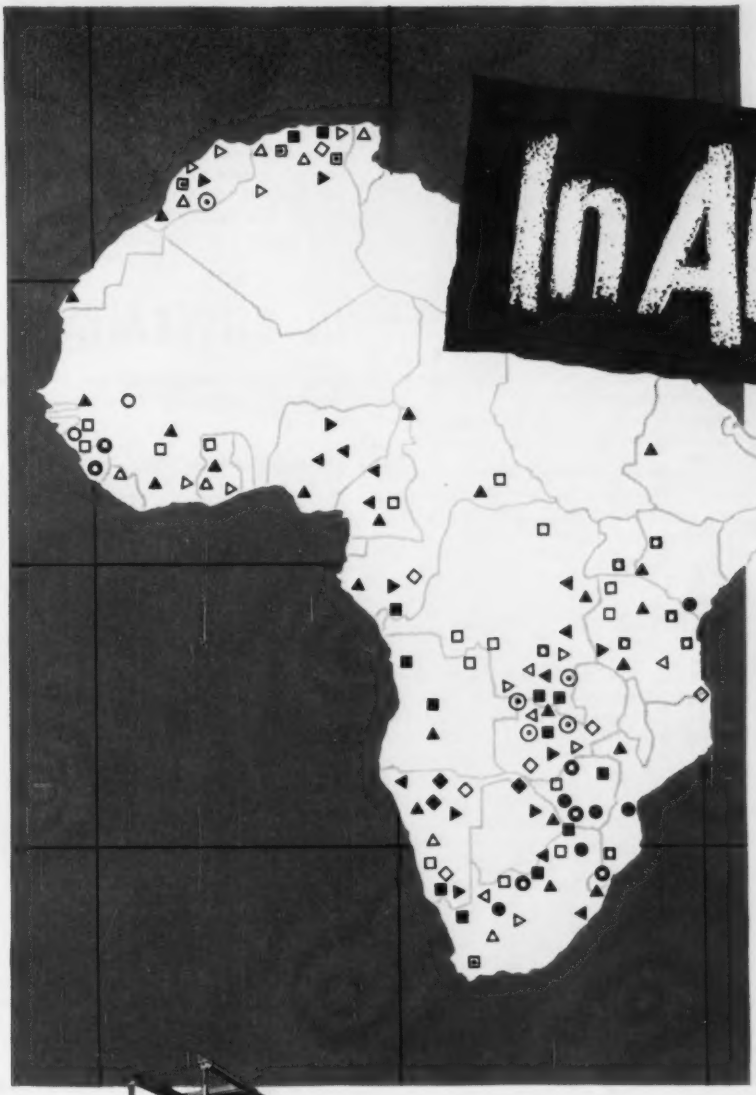
IN LATIN AMERICA

CHILE

The Paipote copper smelter broke all its previous records by producing during last December more than 2,200 short tons of blister.

Paipote is at the present time installing a new 2,500 kw steam turbine and generator of British construction, to work alternately when either of the two present 1,250 kw De Laval turbines are down for repairs.

Cia. Acero del Pacifico, owner of the steel mill in southern Chile with a capacity of 400,000 metric tons of steel a year is going ahead with its project to exploit the Algarrobo iron mine located Southwest of Vallenar. Algarrobo is the



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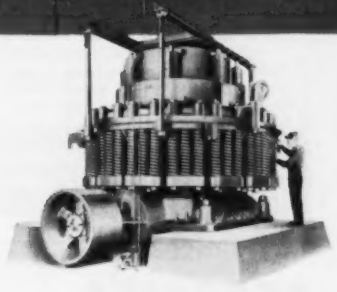

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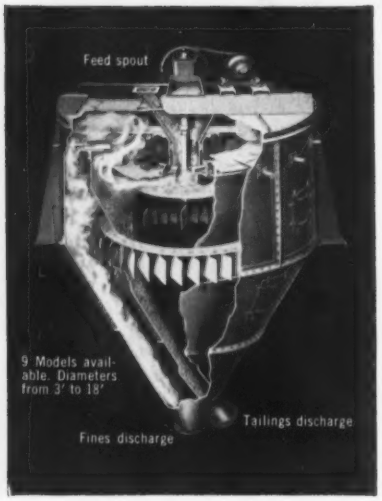

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Chile *(Continued)*

largest proved iron mine in Chile, containing over 100-million tons of high grade iron ore. It has been estimated that over $20-million will have to be spent before the mine is got into production. This sum will go into equipping the open cast mine, the camp, water supply—subterranean wells—railroad and the loading wharf at the port of Huasco.

Mitsubishi is making good progress in getting its Adrianitas iron mine near Copiapo ready for exploitation some time at the end of the present year. An entirely new and difficult paved road is being constructed from the mine to a small harbor north of the port of Caldera where a mechanical loading wharf is being built.

Last year the Nitrate industry only sold 1,230,000 metric tons of sodium nitrate valued at $44-million, down about 250,000 tons from previous years.

MEXICO

Approval has been given to Colossus Nickel Development Ltd. of B.C. for change of name to Alamos Mines Ltd. Move was made because of the company's current activities in developing the Promontorio mine at Alamos. The company shipped approximately 500 tons of run-of-mine ore to smelters in Mexico during 1959 and received $15 per ton for the gold and silver content after deduction of penalties imposed for the presence of some 6% lead and 8% zinc. An accelerated underground program will be pursued during 1960 to place sufficient ore in sight to warrant the erection of a concentrator.

According to a bulletin by the Mexican Sulphur Institute (supported by the U.S. sulphur companies in Mexico), the Mexican sulphur industry produced 1,378,884 long tons of the yellow raw material during 1959—well over last year's production which was under 1-million.

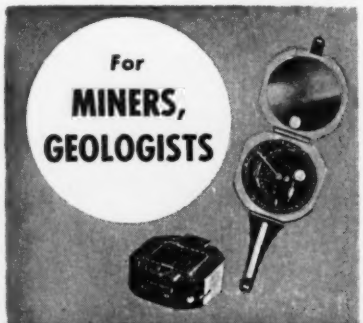
Texas Gulf Sulphur Co. announced suspension of operations at its sulphur plant at Nopalapa, in the State of Vera Cruz.

The decision is a matter of economy according to the company. The Nopalapa plant is a small producer and its cost of operation is high relative to the company's other more efficient producing units.

Since production began in 1957, Nopalapa's output has averaged about 100,000 tons of sulphur annually. This represents less than 4% of the company's total average annual sulphur production.

IN AUSTRALIA

King Island Scheelite Ltd. has reopened for limited-scale operations to meet a



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Australia *(Continued)*

12-month contract. In the absence of substantial price improvement it is not intended to reactivate the mine on large scale.

Queensland Mines Ltd.'s drilling work on Anderson's Lode has resulted in an increase in ore reserves to 1-million tons. The grade is 0.19% U_3O_8. It is possible that further important uranium ore deposits will be discovered in neighboring areas. Good progress has been made in the development of a satisfactory process for the treatment of the ore.

Production of Zinc Corp. Ltd. and New Broken Hill Consol. Ltd. in 1959 was higher than in 1958. Zinc Corp.'s ore treated increased by 8,492 tons to 667,660 tons and production of lead concentrates rose 3,521 tons to 111,253 tons. Zinc concentrates fell 3,474 tons to 111,873 tons and silver output rose slightly from 2,033,955 to 2,045,977 oz. New Broken Hill Ltd. milled 57,608 tons more ore, attaining the 584,530 ton mark. Output of lead concentrates rose from 77,400 to 88,987 tons and zinc concentrates from 119,103 to 128,416 tons. Silver output rose from 1,498,434 to 1,785,540 oz.

Peko Mines N.L. has decided to resume shaft sinking at its Orlando gold prospect on the Tennant Creek field. The shaft will be deepened to 580 ft. A drill hole intersected primary sulphide material assaying 11 dwt over a 25 ft width with one section assaying 18.4 dwt over 10 ft.

As part of its denationalization process, the Australian Federal authorities have called for tenders to purchase the 18-year old Dorset tin dredge and mining leases in northeast Tasmania. "Tin dredging is not an activity the Federal government would wish to see continued in government hands"—said Minister for National Development Senator W. H. Spooner.

The Bulolo Gold Dredging Co. has reopened the Lakekamu goldfield in Papua. The goldfield was discovered in 1909 but the search now will be for gold deep underground.

IN THE PHILIPPINES

Benjamin M. Gozon, director of the Bureau of Mines, has said that in fiscal 1957-58 Philippine mineral producers made progress in spite of adverse world conditions. The export market was highly competitive except for refractory chromite and quicksilver. Metallurgical chrome and manganese face Indian competition, and iron ore exports to Japan have shown little improvement. For the third consecutive year, total mineral production exceeded $100-million, an increase of 11% over 1957-58. The main increases came from sales of gold, up $3-million, copper up $6.5-million, iron

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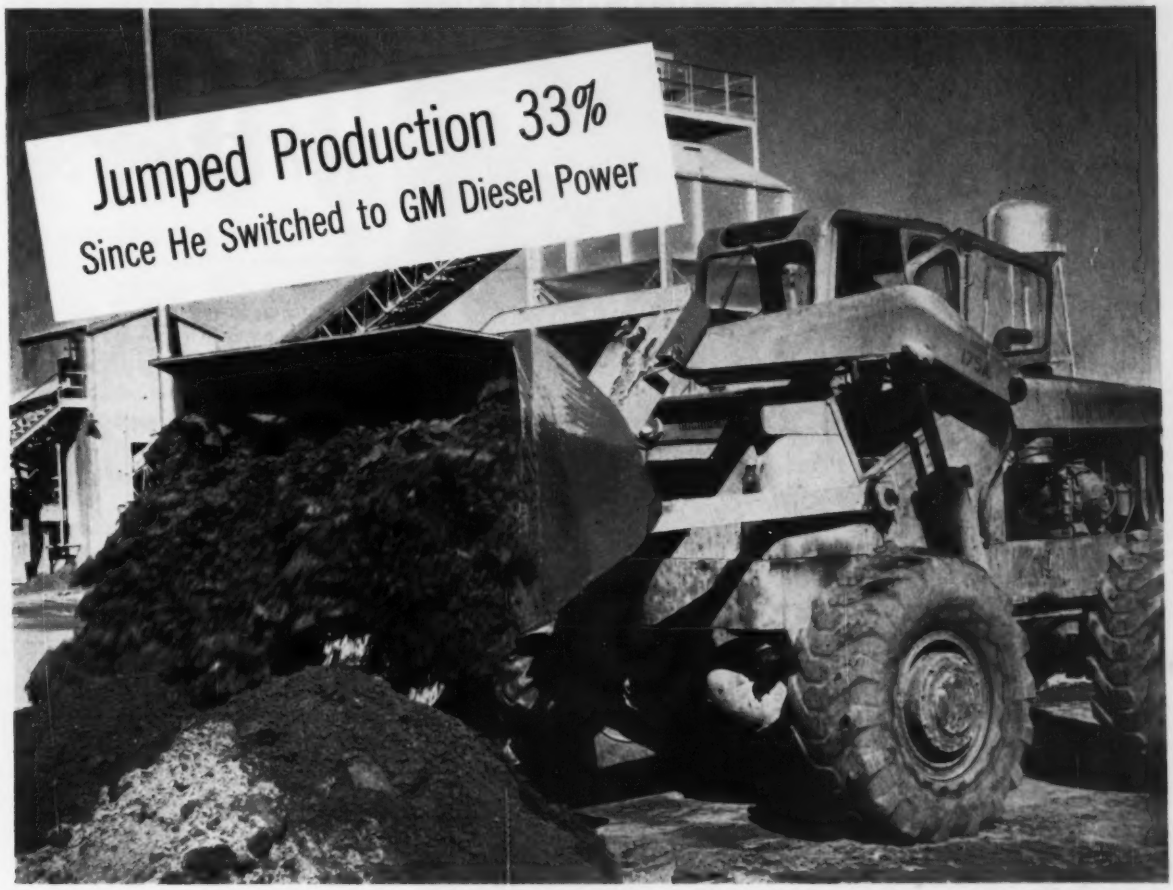

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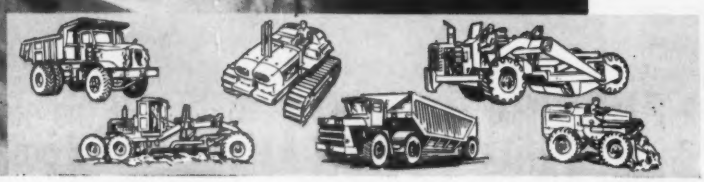

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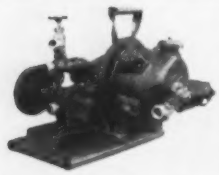

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Philippines *(Continued)*

up $1.3-million. Total gold output was 415,347 oz, copper 49,784 metric tons, and iron ore, 1,227,000 tons.

Philippine base metal producers have petitioned the National Economic Council for unlimited barter privileges to continue operations.

Atlas Consolidated milled 308,000 tons of low grade copper ore at its Toledo mill in December. Shipments during the month totalled 6,396 tons of concentrates, estimated to contain 3,487,000 lb of copper. In addition, 5,000 tons of pyrites were shipped to the National Power Corp. From the Mati mine in Davao, 23,600 tons of iron ore were sent to Japan. S. Z. Misa has been appointed resident manager at Mati by Soriano & Co.

Liberty Chrome Mining Co. shipped 1500 tons of metallurgical chromite ore to New York. Other shipments; Philex Mining Co. shipped 1,001 tons of copper concentrates in December to Japan. Itogon-Suyoc Mines, managed by Marsman & Co., milled 15,800 tons in December from the Itogon mine and 4,600 tons from Suyoc. Benguet Exploration milled 1,100 tons. Benguet Consolidated operated normally. Encouraging new gold ore was opened up in the old mine which now accounts for practically all the output.

IN AFRICA

The No. 3 Shaft of President Brand, one of the Anglo American mines in the Orange Free State, is now less than 600 ft from its expected depth of the Basal Reef. Towards the end of January both the main shaft below the collar and the ventilation shaft had reached depths of over 4,000 ft. The shaft system is to be commissioned towards the end of the year. Development from No. 3 Shaft will influence the expansion of the milling capacity of the mine. It is estimated that within the next two or three years —depending on development from No. 3 Shaft—it is planned to increase the rate from the current level of 115,000 tons to 150,000 tons.

Rhodesia Broken Hill Development Co. has decided to go ahead with the development of a new $11.2-million smelting furnace at Broken Hill in Northern Rhodesia.

The new furnace and ancillary equipment will reduce production costs and at the same time increase the combined recovery of lead and zinc from currently mixed ore from 60% to more than 85%. The company will also be able to extract 200,000 long tons of zinc and lead from accumulated stocks of high-grade oxidised products which are at present untreatable.

The new process is expected to be in operation early in 1962 and will raise annual production figures to 28,000 long tons of lead and 55,000 long tons of zinc—almost double the present average annual outputs.

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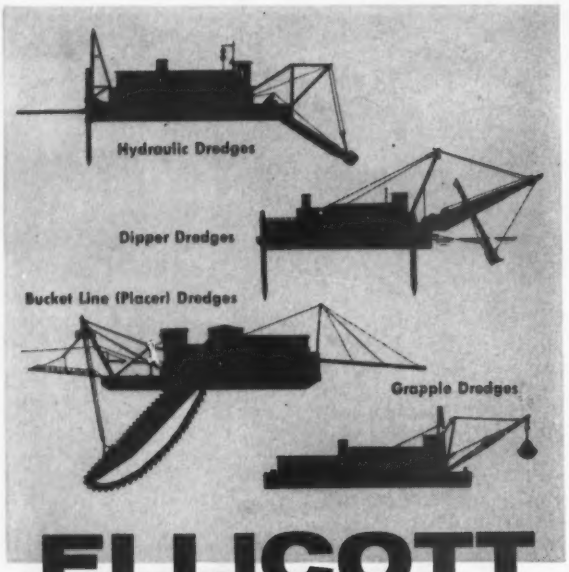

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When your mining problems are dredging problems, we can help you solve them.

For nearly 75 years, Ellicott engineers have designed and built dredges best suited to the needs of the job. With this experience we can make unbiased recommendations on any type or size of dredge so that you will get the right one for your project.

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3020

For full information on Ellicott dredges and dredging equipment for mining, write to: Ellicott Machine Corporation, 1633 Bush Street, Baltimore 30, Md., or 525 Market Street, San Francisco, Calif.

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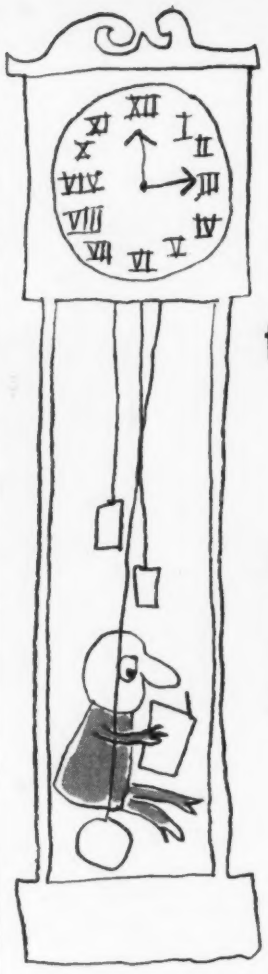
Successors to the floating dredge business of the Bucyrus-Erie Co. and the American Steel Dredge Co. Complete engineering, design and construction services.



Why is it that the really busiest men always seem to have the most time to read?

Not long ago, we talked with the president of a huge international organization . . . an executive who commands more than fifty companies in 29 countries. He confessed to being an ardent reader of a certain McGraw-Hill magazine.

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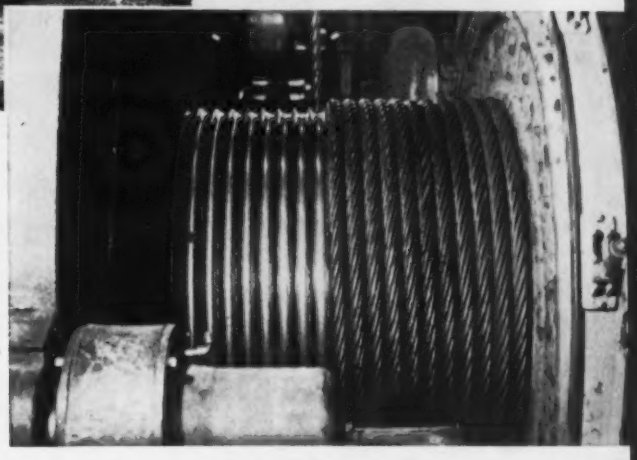
And how about others in your department? Surely, there must be some qualified men-on-the-way-up whom you could help by passing along this issue . . . and with this particular page well marked. Wouldn't you like them to know, as you know, that . . .

Men who read more . . . earn more!

2¾" Tiger Brand hoist ropes going through the boom point sheaves.

40-cubic-yard shovel stripping overburden at the Little Sister Mine of the Truax Traer Coal Company, St. David, Illinois.

Main hoist drum with well-lubricated Tiger Brand Rope in excellent condition after long service.



USS Tiger Brand— America's No.1 Wire Rope used on most big shovels

This 40-cubic-yard shovel, owned by the Truax Traer Coal Company, has been removing overburden at the Little Sister Mine near St. David, Illinois, for more than nine years. The hoist line is a 550-foot, 2⅜-inch diameter Tiger Brand Wire Rope, and the four boom supports are also Tiger Brand.

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1. It is made by a company that maintains the most complete wire rope research and manufacturing facilities in the country.
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4. It is made by one company, U.S. Steel, and every step of production, from ore to finished product, is carefully controlled and supervised to guarantee one high standard of quality.
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POSITION VACANT

Position Open-Operations Research Engineer- Medium sized nonmetallic processing plant-fine grinding and materials handling experience desirable. Should have training in mineral processing and minimum of three years experience. Northeast. Submit complete record. P-2674, Engineering & Mining Journal.

Shaft Sinking Foreman—with experience in concrete lining and grouting. Take charge sinking two (2) shafts. Location—Far East. Status—Single. Contract—One (1) year. Salary—Open. Must be available June 1st. P-3862, Engineering & Mining Journal.

Diamond Drilling Foreman—must have had responsible charge or large drilling project, preferably with foreign experience. Location—Far East. Status—Single. Contract—One (1) year. Salary—Open. Must be available June 1st. P-3860, Engineering & Mining Journal.

Mining or Metallurgical Engineer, Graduate, minimum one year experience, for 500 T.P.D. Open Pit non-metallic operation. Primary work involves project engineering in gravity and flotation plants with some construction and sales. Good opportunity. Salary $6,000-8,000. Location—Northeast. P-3784, Engineering & Mining Journal.

Senior Geologists, Geologists, Assay-Chemist for field teams prospecting for metallics and non-metallics in Yemen. Minimum 3 years experience required. Single or agreeable to family separation for initial 2 year period. Challenging work in completely unexplored area. Write for Application AOIC, 1411 "K" Street, NW, Suite 1400, Washington, DC.

(Continued on following page)

WANTED
RESIDENT GEOLOGIST

Graduate degree in mining geology and minimum 7 years' experience in hard-rock mining geology at nonferrous, operating mining properties required. Opening in Chile with large North American company. Age 30-40, knowledge of Spanish not essential but desirable, salary commensurate with experience.

Reply in full confidence with complete and detailed résumé to

P-3777 Engineering & Mining Journal
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BS or MS Degree Industrial or Mechanical Engineering with post graduate studies production control, tool design, material handling, industrial psychology, etc. Practical industrial experience required with at least 2 years supervisory capacity in fabricating industry. Experience as machinist or tool maker desirable.

Excellent opportunity large copper company Chile, South America. 2 year contract with transportation both ways and salary while traveling paid by Company. In reply give complete details.

P-3652 Engineering Mining Journal
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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Rapidly expanding mining and manufacturing concern with vast holdings in varied mining activities has recently acquired large SILICA PROPERTIES and has need for a **GENERAL MANAGER** to assume complete responsibility for sales distribution and/or mining and processing operations.

Successful applicant will be a man who has a thorough knowledge of silica processing and markets for silica and silica by-products. Background of successful accomplishment in industry extensively selling or using silica essential. Only qualified persons need apply.

A real opportunity for right man. Salary commensurate. Write full details in complete confidence.

P-3616—ENGINEERING MINING JOURNAL
520 N. Michigan Ave., Chicago 11, Ill.

WANTED

CHIEF STOREKEEPER

Required by large North American mining company for assignment at operating properties in Peruvian Andes. College degree with minimum 3 years' experience in mining or industrial warehousing required. Age to 40, salary commensurate with experience, transportation, single or married housing, plus other benefits.

STOREKEEPER with degree and one-year experience also required.

Reply with full particulars to:

P-3775 Engineering & Mining Journal
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Prominent manufacturer of crusher and process machinery has challenging position for Sales and Service Representative with excellent opportunity for advancement. Must have minimum of 5 years heavy machinery sales experience in mining, crushed stone, sand and gravel, or cement industries. Prefer technical background in Mechanical, Metallurgical, or Mining Engineering.

Write stating age, education, experience, present employment and salary requirements. Replies strictly confidential.

P-3769 Engineering & Mining Journal
520 N. Michigan Ave., Chicago 11, Ill.

FOREIGN EMPLOYMENT

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B. S. in Mining Engineering. Position also requires fluent knowledge of Spanish and English. Should have several years in responsible supervisory position in underground mining, preferably block caving. Primary function would be to translate into execution all planning and coordinate all operations required for the mining of 34,000 tons daily.

Excellent opportunity large copper company, Chile, South America. 2 year contract with transportation both ways and salary while traveling paid by Company. In reply give complete details.

P-3845 Engineering & Mining Journal
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

POSITIONS VACANT

(Continued from preceding page)

Shift Foreman for underground mine in South America. Must speak Spanish and have experience in Latin America. Transportation paid. Pleasant climate. P-3691, Engineering & Mining Journal.

POSITIONS WANTED

Superintendent—Mining or Construction. Age 39, E.M. degree 1947. Experience underground mining, surface plant construction, shaft sinking. Registered P.E. (Utah). Resume on request. PW-3291, Engineering & Mining Journal.

Consulting Mining Engineer-Geologist desires to manage or contract-mine small equipped operation; also exploration and valuation reporting for investment groups; metallics, nonmetallics, petroleum; experienced in all; graduate. PW-3521, Engineering & Mining Journal.

Manager—Superintendent—Staff Engineer. Metallurgical Engineer, 39. Diversified experience, open pit mining, beneficiation, hydrometallurgy, pyrometallurgy, agglomeration. Several years top operating staff experience large and medium size operations. Strong background in organization, cost reduction and administration. Domestic and foreign experience. PW-3392, Engineering & Mining Journal.

Metallurgist—30 years old, 7 years experience in all phases of copper concentration and smelting in North and South America. Desires position in developmental research. Married. Foreign preferred. PW-3414, Engineering & Mining Journal.

You got problems??? Me too—29 year old ball-of-fire metallurgist wants work, and lots of it. 7 years of operational research in concentrating and smelting. Married. Have slide rule—will travel. PW-3418, Engineering & Mining Journal.

Production or Engineering—Age 28—Registered P.E.—Sound experience in high capacity hard and soft rock mining and plant construction. Extensive background in production and cost analysis. Position with challenging responsibilites and opportunity essential. Location immaterial. PW-3840, Engneering & Mining Journal.

Geologist, 29, M.S., 5 years domestic and foreign experience in mineral exploration. Responsible assignments in mine examination, field and photo mapping. Speaks Spanish, German. Employed. PW-3737, Engineering & Mining Journal.

In Northwestern U.S.—Responsible production or construction position desired by mining engineer, 34, with underground, surface, construction, project, exploration, and plant management experience. Available spring. Now employed large industrial mineral and manufacturing firm. Wish to relocate for personal reasons. Opportunity essential. PW-3644 Engineering & Mining Journal.

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2—3" United, 5 Stage, 350 GPM, 600 ft. head
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1—8H-42" Jeffrey "Aerodyne"
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2—6 Ton General Electric, type LSBE-2C6
1—7 Ton Atlas
2—8 Ton General Electric, type LSB-2C8
1—8 Ton Goodman, type 42C04T
3—8 Ton Ironton, type WO
1—9 Ton Whitcomb
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1—112½ KVA Louis Allis, 3/60/440—Caterpillar DC17000, 8 Cylinder Diesel
1—75 KVA GE, 3/60/2300—Caterpillar D13000 6 Cylinder Diesel
1—37½ KVA Century, 3/60/115-220—Buda, 6 Cylinder, 56 HP Diesel
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1—60" x 150" Belt Conveyor, steel frame, 100 HP. West. gear motor 220/440 V
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1—36" x 625' Link Belt steel frame, 2 only 100 HP. West. Gearmotors, 220/440 V.
1—42" x 870' Link Belt, trailing belt type with movable stacker, and 36" x 70' stacking conveyor, 100 HP. West. Gearmotor

Crushers
1—36" x 42" Birdsboro Buchanan Jaw, 100 HP.

Hopper
1—14½' x 13' x 10' deep Dump hopper station complete with hydraulic operated grizzly, 48" x 8' plate feeder, 10 HP. Gearmotor

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2—24' x 8' Process Eng., steel tank, 7½ HP.

Pumps
1—14" Yuba Centrifugal, 5500 gpm, 250 HP.
1—14" Yuba Centrifugal, 5500 gpm, 125 HP.
1—10" Yuba Centrifugal, 2400 gpm, Less motor.
1—16" Wintroath Deepwell, 2000 gpm, 100 HP.
1—16" Wintroath Deepwell, 2000 gpm, 100 HP.

Pumps, Diagrams and Sand
2—8" Darree Duplex, Type W, 5 HP. TEFC Motor
3—6" Darree Duplex, Model VM, 3 HP. TEFC
3—6" x 6" Allis Chalmers, NRLOR, 30 HP. motor

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Campco H S 418 H T Separator

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4—12'6" x 4' wide Convey Co. Sandwheels, 20 HP. Gearmotors

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1—Model 111 Marion Diesel Electric, 4 yd. shovel front, complete with 100' Dragline Boom and 3½ yd. Esco Bucket
1—Model 170-B Bucyrus Erie Electric, 7 yd. 375 HP. AC Motor, 2400/4160 Y & Esco Bucket

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1—250' dia. x 14' Dorr Traction Type, Type MC, Less tank, 7½ HP Gearmotor, 220/440 V.

Weightometer
1—Merrick, Model E, 36" Belt, with Recorder

At Patterson, Idaho

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1—15' x 20' circular Steel ore Bin

Classifier
1—4 x 15 Dorr Duplex, Rake, DSF
1—EE 1040 Equipment Engineers

Compressor
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1—285 CFM G.D. Model WBH

Conveyor
1—18" x 178' Link Belt Conveyor, Steel Frame
1—18" x 155' Link Belt Conveyor, Steel Frame
1—18" x 20½' Link Belt Conveyor, Steel Frame

Crusher
1—Size 50 KUE Ken Jaw Crusher, 25 HP.

Feeder
1—36 x 8'-4" Link Belt Apron, 3 HP.

Flotation Machine
1—8 cell Gallgher, 36", 7½ HP. motor

Jigs
1—26" x 20" Beadalari Simplex Mineral Jig

Locomotive
4—1½ Ton Mancha "Little Trammer" 18" Ga. Comp.
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Mill
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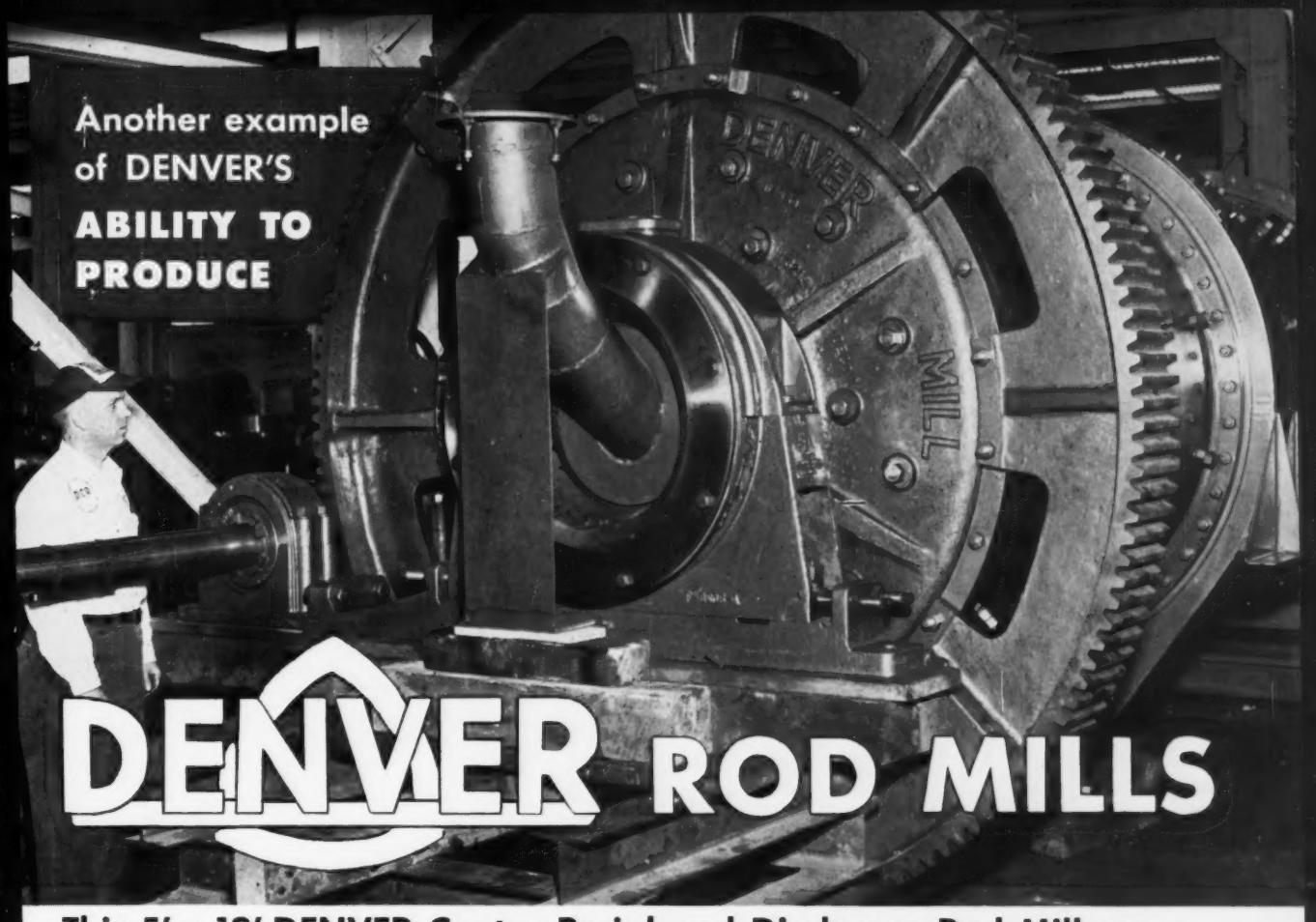

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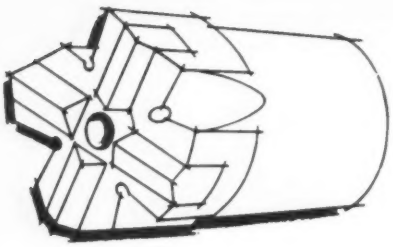

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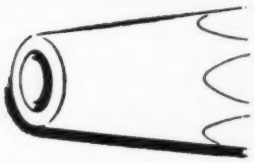

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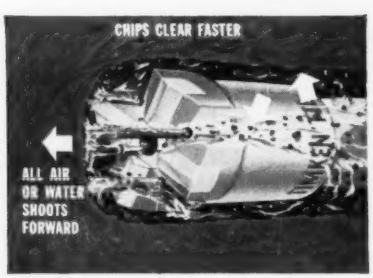
Notice at right how the new frontal design of the Timken tapered bit clears chips faster for extra savings. And new, special-analysis carbide inserts give superior wear-resistance, added shock-resistance. They can be reconditioned many times.

Get *all* these savings. Switch to the new Timken tapered bit. For free brochure write: The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.



CHIPS CLEAR FASTER because 1) five front holes shoot water or air directly against the rock face and 2) deeper, wider wing clearance lets chips wash back faster.

TIMKEN®

removable rock bits